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Fred A. Henny, D.D.S., Editor

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The concentration factor in local anesthetic solutions

■ *E. Cheraskin,* M.D., D.M.D., and C. Brunson, Jr., B.S.,† Birmingham, Ala.*

An increase in the concentration of a local anesthetic drug or its accompanying vasoconstrictor up to a certain level will influence favorably the rate of onset, depth, spread, and duration of anesthesia. A given dose of drug is more effective in a smaller total volume of injected fluid.

Despite the numerous articles which have appeared in the literature regarding local anesthesia, relatively little consideration has been directed specifically to the problem of the concentration of the injected solution.

This report will attempt to review the available information on the subject of the concentration factor. The criteria for incorporation of material in this report include: (1) the data must deal specifically with the concentration factor, (2) the observations have been made on human subjects, and (3) the presented data are quantitatable.

In order to analyze the concentration factor, it is necessary first to review the conventional criteria used for the evaluation of local anesthetic agents.

■ *Criteria for Acceptable Local Anesthesia*

The two most important physiologic ingredients of local anesthetic agents are: (1) the local anesthetic solution itself, and (2) the vasoconstrictor substance.

LOCAL ANESTHETIC SOLUTIONS—Sherman and co-workers,[1] as well as other investigative groups, have outlined the criteria for an acceptable anesthetic solution. Eight specifications generally are listed. First, a local anesthetic agent must be as free as possible from toxicity. Second, the agent must be relatively free of properties which will irritate the tissues into which it is to be injected. Third, the material must possess a degree of stability necessary for storage. Fourth, the effects of an acceptable solution must be revers-

ible so that physiologic sensation is restored within a reasonable interval of time after injection.

The remaining four criteria are of greater interest to the practitioner because: (1) they determine the course in clinical use, and (2) the clinician has more direct control over them. The first criterion, in this regard, is the induction time. With all other factors constant, it is highly desirable that anesthesia develop quickly. The second criterion is the depth of anesthesia. It is realized that desired depth will vary with the type of patient and nature of the operation. The third criterion is that an acceptable anesthetic solution must have a duration period that is satisfactory. Here again, different procedures for different operators make satisfactory duration different. The final criterion is that the ideal solution must be free of idiosyncratic effects.

VASOCONSTRICTOR AGENTS—Criteria are also available for the ideal vasoconstrictor solution.[2] Consideration is usually given to four items. First, the effect of the vasoconstrictor substance on duration of anesthesia; second, the vasoconstrictor substance should serve to minimize the toxicity of the local anesthetic solution; third, the potential hemostatic effect of a vasoconstrictor substance is judged; finally, systemic effects customarily are considered.

■ *Analysis of Local Anesthetic Agents*

An attempt will be made in this section to analyze the presently available data regarding local anesthetic solutions in terms of: (1) induction time, (2) depth of anesthesia, (3) extent (spread) of anesthetic effect, and (4) duration of anesthesia.

INDUCTION TIME—Huldt[3] performed a series of experiments on 32 human subjects. One of the factors which he considered was the speed of onset of anesthesia (induction time). In all instances, the solution was injected supraperiosteally over the maxillary lateral incisor. Anesthesia was determined by the lack of response to a maximal electrical stimulus (Bjorn technic[4]). Figure 1 shows the results of his studies. It can be observed that, under conditions of constant volume (1 ml.) and constant vascoconstrictor (in every instance 1:40,000 epinephrine), the induction time decreased with an increase in the concentration of the local anesthetic solution. A ten minute latency can be observed with a 0.5 per cent procaine hydrochloride solution and an almost 50 per cent decrease in induction time when a 1 per cent procaine solution is injected. The curve begins to level off as the concentration is increased beyond 2 per cent. It is also interesting to note the shorter induction times with lidocaine (Xylocaine) as compared with procaine.

Dobbs and co-workers[5] compared 0.5 and 0.75 per cent propoxycaine (Ravocaine) with 1:30,000 levarterenol with respect to induction time. The time from the withdrawal of the needle until the patient perceived numbness in the anesthetized region was regarded as the induction time. The conclusion was drawn that the onset of anesthesia is much more rapid with the 0.75 per cent solution of propoxycaine as compared with the 0.5 per cent agent.

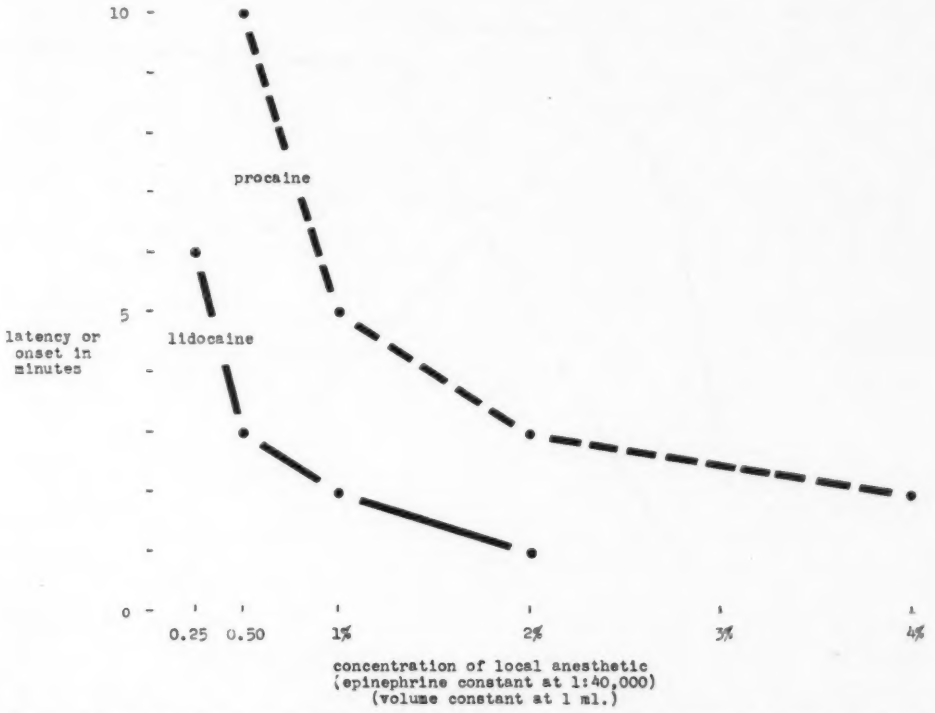

Fig. 1—Comparison of procaine hydrochloride and lidocaine hydrochloride in terms of latency or onset of anesthesia

DEPTH OF ANESTHESIA—Huldt, in the series of experiments previously quoted,[3] also analyzed the depth of anesthesia. This was charted by recording the percentage of persons who did not respond to electrical stimulation.[4] Figure 2 shows that increase in procaine concentration is associated with greater percentage of subjects with no response to electrical excitation. It appears, from this chart, that a limit is reached at 2 per cent and further increase in procaine concentration does not significantly alter the findings. It is noteworthy that concentrations of lidocaine, at lower than procaine concentrations, yield greater effectiveness (Fig. 2).

Huldt[3] also studied the effect of total volume of solution on depth of anesthesia. It can be observed (Fig. 3) that the same amount of lidocaine (20 mg.) in decreasing total volume of injected fluid yielded greater anesthetic depth. This same relationship is underlined in other studies by the same author demonstrating that 4 per cent lidocaine (in 1 ml.) induced complete anesthesia in three out of every four subjects. In contrast, similar results were obtained in only 60 per cent of the patients with the same amount of lidocaine in greater volume (2 ml. 2 per cent).

Dobbs and co-workers[5] compared propoxycaine 0.5 and 0.75 per cent with

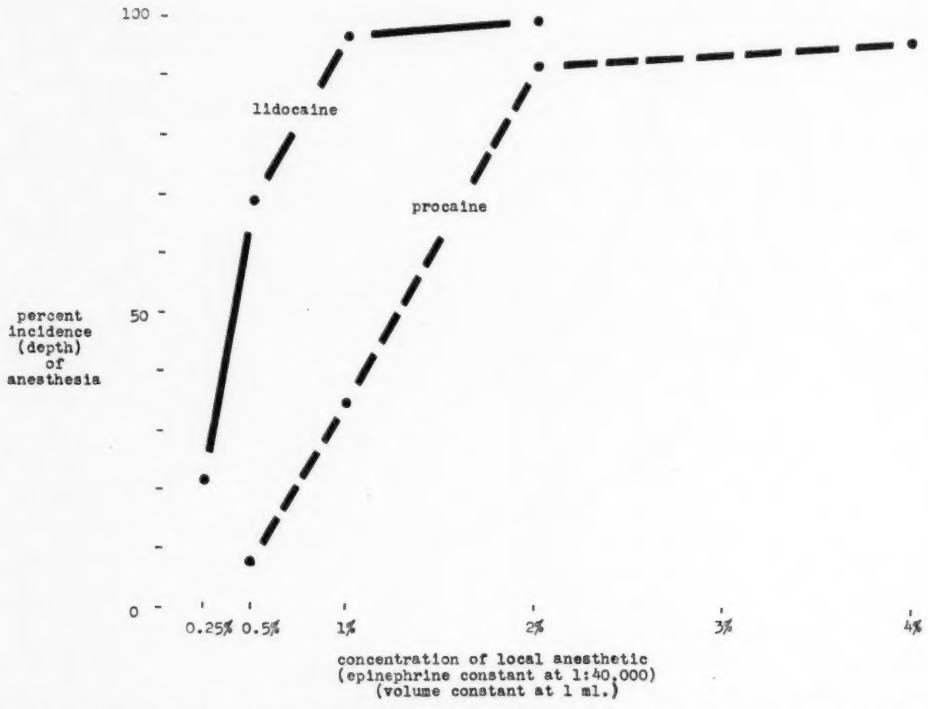

Fig. 2—Comparison of procaine hydrochloride and lidocaine hydrochloride in terms of per cent incidence (depth) of anesthesia

1:30,000 levarterenol with respect to anesthetic depth. Anesthesia was graded as follows: (1) grade A indicated absolute freedom from pain during the operation, (2) grade B represented pain experienced during the operation but additional anesthetic solution was not needed, and (3) grade C designated pain experienced that required injection of more anesthetic solution. The conclusion was drawn that there is a slight advantage in the 0.75 per cent propoxycaine solution.

EXTENT OF ANESTHESIA—The extent of local anesthesia is defined as the degree to which adjacent teeth show loss of sensation. In other words, the percentage of individuals with anesthesia about the central incisor and cuspid when local anesthetic solution is injected into the region of the lateral incisor has been utilized as an index of spread of the anesthetic effect.

Huldt[3] investigated the spread of anesthesia after the injection of the substance in the region of the maxillary lateral incisor. Thirty-two subjects received 1 ml. of anesthetic solution with the same concentration of vasoconstrictor agent. Figure 4 shows that spread increases with increase in procaine concentration. Figure 4 also demonstrates the greater spread after the use of lidocaine.

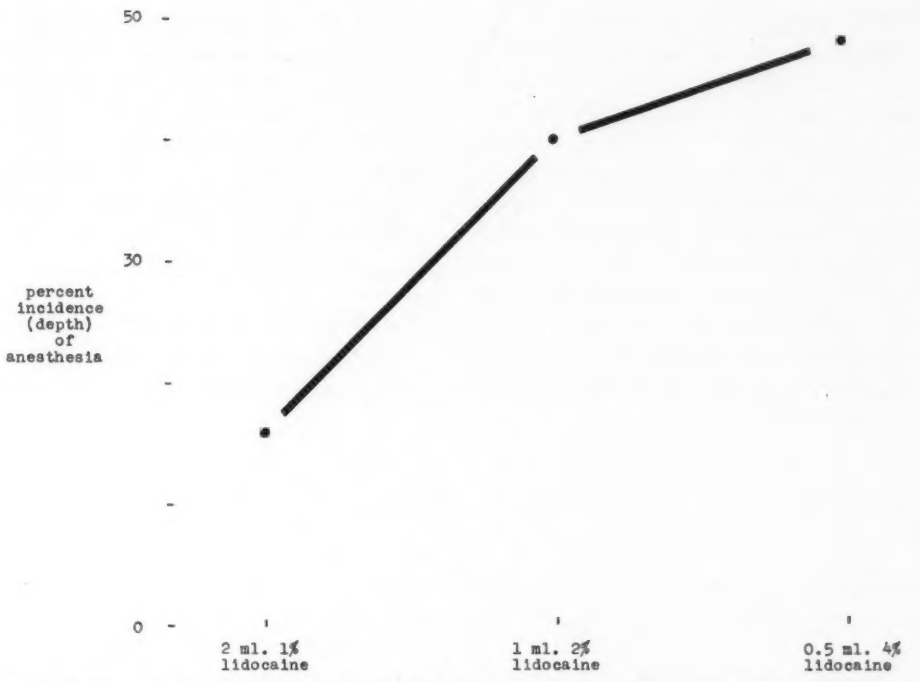

Fig. 3—Comparison of per cent incidence (depth) of anesthesia versus concentration of lidocaine hydrochloride when drug dose is constant at 20 mg.

Twenty-five subjects were injected with the same amount of vasoconstrictor-free lidocaine (20 mg.).[3] It was found that anesthetic spread paralleled decrease in total volume of injected solution. This observation is consistent with conclusions previously drawn with regard to decreasing volume and anesthetic depth.

This same observation is, in part, confirmed in another experiment.[3] Figure 5 shows there is greater spread with 1 ml. 2 per cent than with 2 ml. 1 per cent lidocaine.

DURATION OF ANESTHESIA—Huldt[3] also studied the duration of local anesthesia after the supraperiosteal injection of substances over the maxillary lateral incisor. In one study of 32 subjects, the volume of solution was kept constant at 1 ml. and the epinephrine concentration was maintained at 1:40,000. Figure 6 shows duration increases with increase in concentration of local anesthetic agent.

Dobbs and co-workers[5] compared propoxycaine 0.5 and 0.75 per cent, both with levarterenol 1:30,000, with respect to duration of anesthesia and working time. The duration of anesthesia was the time from needle withdrawal until the last evidence of numbness vanished. Working time was considered to be the interval from withdrawal of the needle until pain caused by instrumentation returned or

until operation was terminated. It was shown that the working time when 0.75 per cent propoxycaine was used was longer than that for the 0.5 per cent solution whereas there was only a small difference in the duration of anesthesia.

In a different series of 25 subjects[3] injected with 20 mg. lidocaine in varying amounts of solution, it was found that there was little difference in duration after the injection of 2 ml. 1 per cent as against 1 ml. 2 per cent lidocaine. However, anesthetic duration was increased when 0.5 ml. 4 per cent solution was injected.

Finally, in another study,[3] an attempt was made to analyze duration against volume of solution. It can be observed (Fig. 7) that 1 ml. 2 per cent is more effective than 2 ml. 1 per cent. However, these relationships do not obtain with the higher concentration solutions (that is, 1 ml. 4 per cent as against 2 ml. 2 per cent).

■ *Analysis of Vasoconstrictor Agents*

An attempt will be made in this section to analyze the presently available data

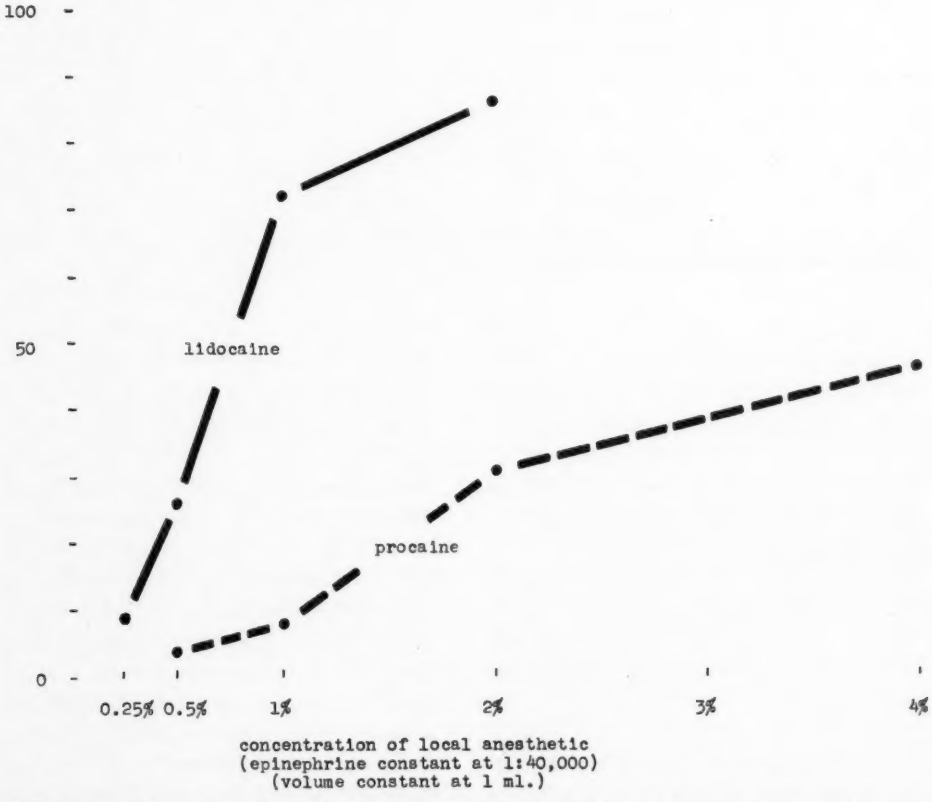

Fig. 4—Comparison of procaine hydrochloride and lidocaine hydrochloride in terms of per cent extent of anesthesia

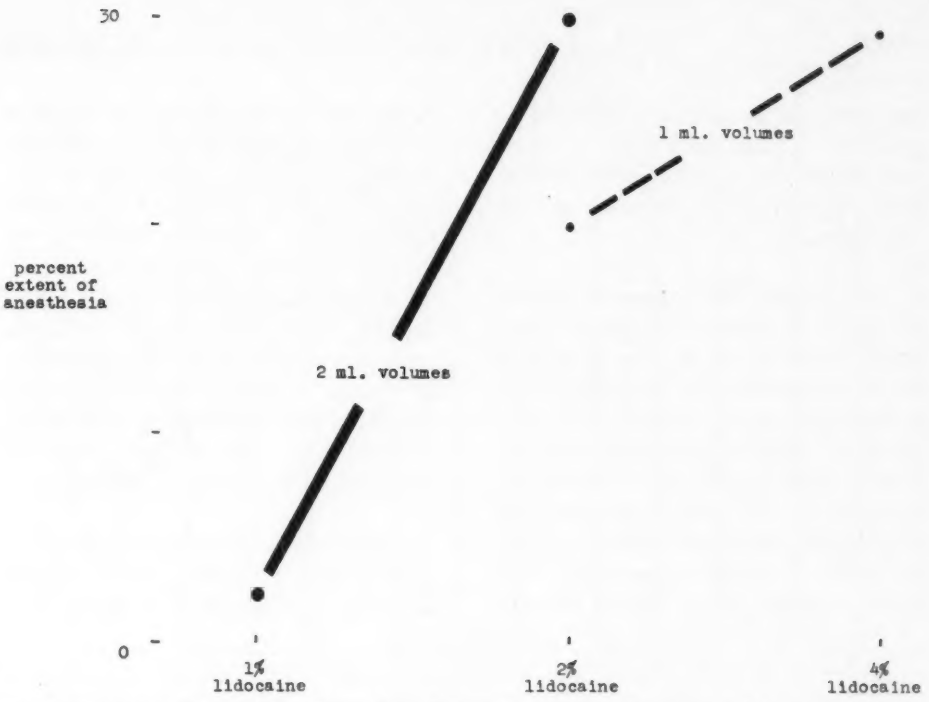

Fig. 5—Comparison of per cent incidence of anesthesia with 1 per cent, 2 per cent and 4 per cent lidocaine hydrochloride in varying volumes

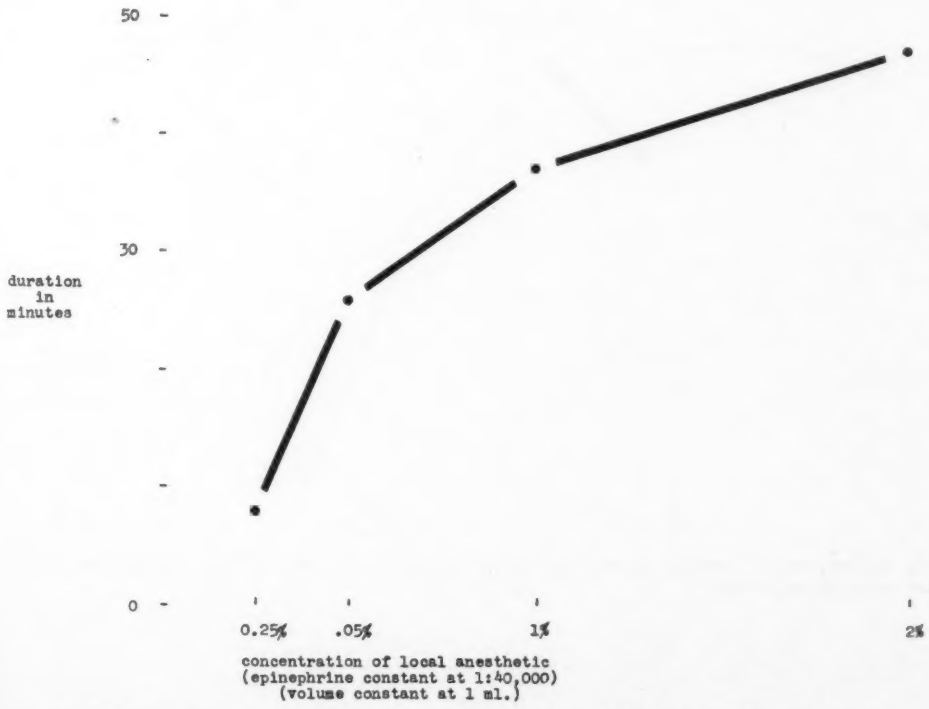

Fig. 6—Comparison of varying concentrations of lidocaine hydrochloride and duration of anesthesia

regarding vasoconstrictor substances in terms of: (1) induction time, (2) anesthetic depth, (3) extent (spread) of anesthesia, (4) anesthetic duration, and (5) side-effects.

INDUCTION TIME—Kramer[6] studied the speed of onset of anesthesia under conditions in which the concentration of the local anesthetic solution remained the same. Specifically, he compared 2 per cent lidocaine 1:50,000 epinephrine with lidocaine 1:100,000 epinephrine. He also investigated 1.5 per cent metabutoxycaine (Primacaine) with 1:60,000 epinephrine and with 1:125,000 epinephrine. The lack of response to the rotation of a bur in the dentin was used as the index of anesthetic efficiency. Figure 8 shows his findings. It appears, in the case of lidocaine, that greater amounts of epinephrine produce faster induction. However, the converse is shown with metabutoxycaine.

Costich[7] studied the relative induction time of 2 per cent procaine and 2 per cent procaine with 1:50,000 epinephrine in a series of patients in whom inferior alveolar block anesthesia was utilized. He observed more rapid induction with the epinephrine-free anesthetic solution.

DEPTH OF ANESTHESIA—Huldt[3] studied the depth of anesthesia in 37 subjects after the supraperiosteal injection of a

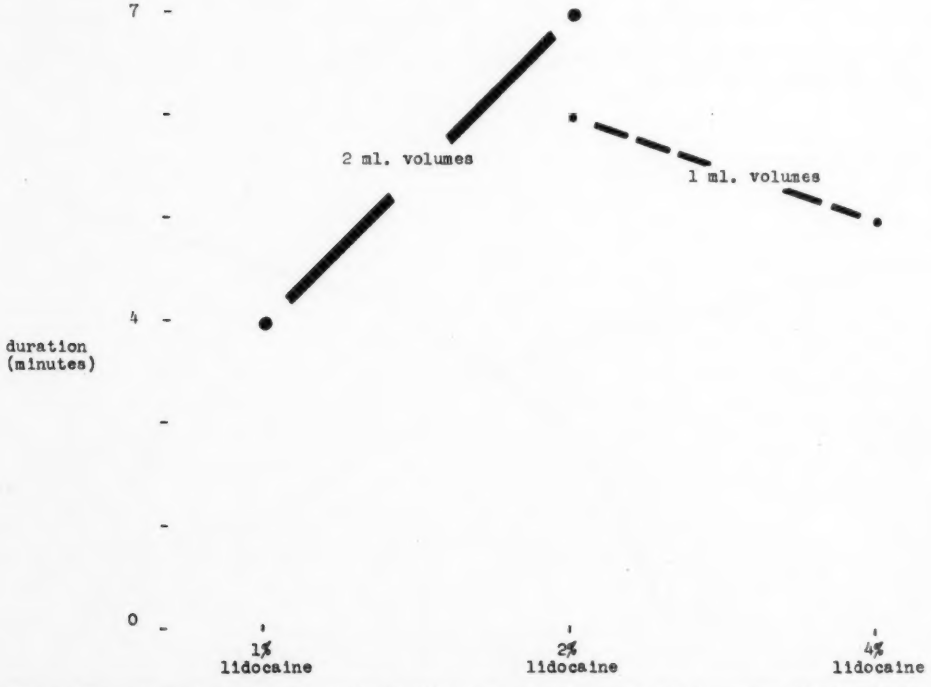

Fig. 7—Comparison of duration of anesthesia with 1 per cent, 2 per cent and 4 per cent lidocaine hydrochloride in varying volume

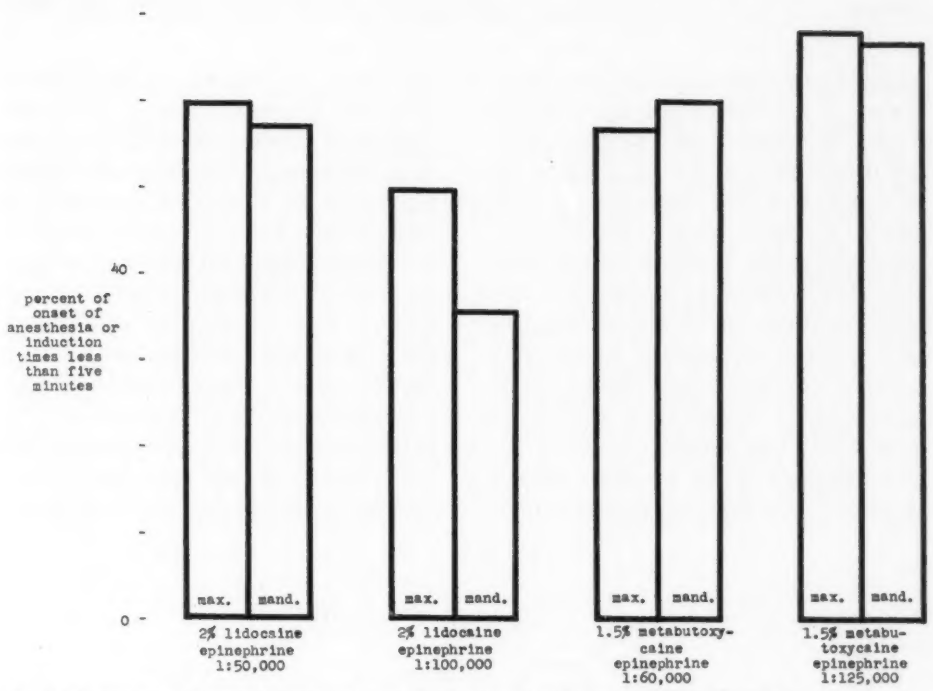

Fig. 8—Comparison of onset of anesthesia or induction time of lidocaine hydrochloride and metybutoxycaine hydrochloride with different concentrations of epinephrine

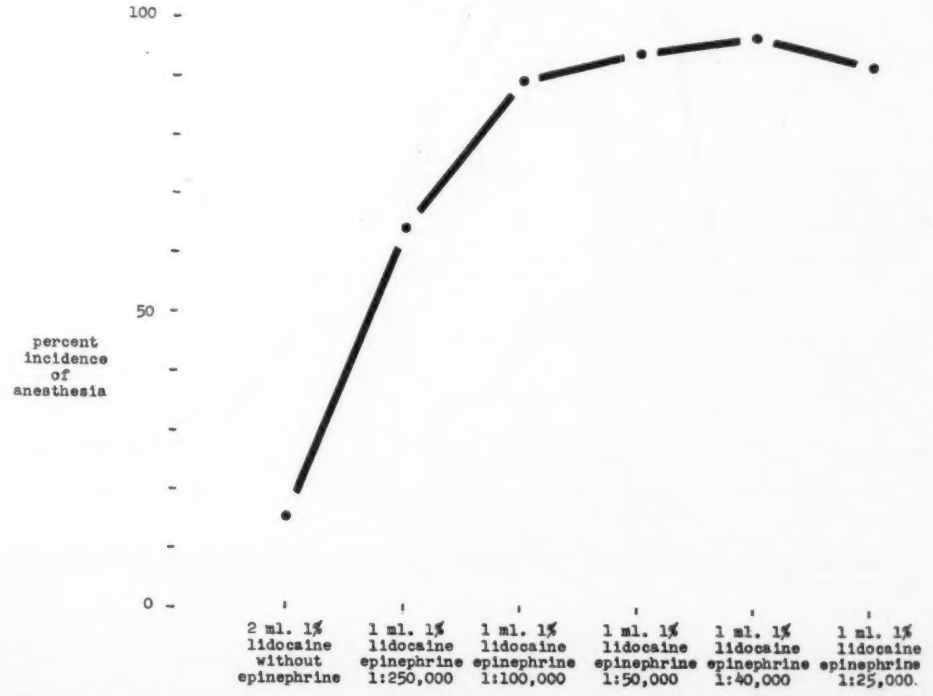
100
50
0
percent incidence of anesthesia
2 ml. 1% lidocaine without epinephrine
1 ml. 1% lidocaine epinephrine 1:250,000
1 ml. 1% lidocaine epinephrine 1:100,000
1 ml. 1% lidocaine epinephrine 1:50,000
1 ml. 1% lidocaine epinephrine 1:40,000
1 ml. 1% lidocaine epinephrine 1:25,000.

Fig. 9—Comparison of per cent incidence of anesthesia versus 1 per cent lidocaine hydrochloride with varying concentrations of epinephrine and without epinephrine

constant amount of lidocaine with different concentrations of epinephrine. Figure 9 shows the rapid increase in depth up to a point after which the curve levels off.

Huldt[3] injected supraperiosteally 1 ml. 2 per cent procaine without epinephrine over the region of the maxillary lateral incisor in ten test subjects. In no instance was there an absence of response to a maximum electrical stimulus.[4] This can be interpreted to mean that satisfactory anesthetic depth was not obtained. The solution, nevertheless, was not wholly without effect on the sensitivity of the teeth. A near maximum threshold value was obtained in two out of the ten subjects. The addition of epinephrine 1:40,000 to the same procaine solution resulted in a radical change in the activity of the anesthetic, giving a 78 per cent incidence of anesthesia.

Kramer[6] compared the depth of anesthesia during the clinical use of 2 per cent lidocaine with 1:50,000 and with 1:100,000 epinephrine. He also analyzed the relative effectiveness of 1:60,000 and 1:125,000 epinephrine with 1.5 per cent metabutoxycaine. Depth was scored on a three-point system. Grade A consisted of complete elimination of pain. Grade B in-

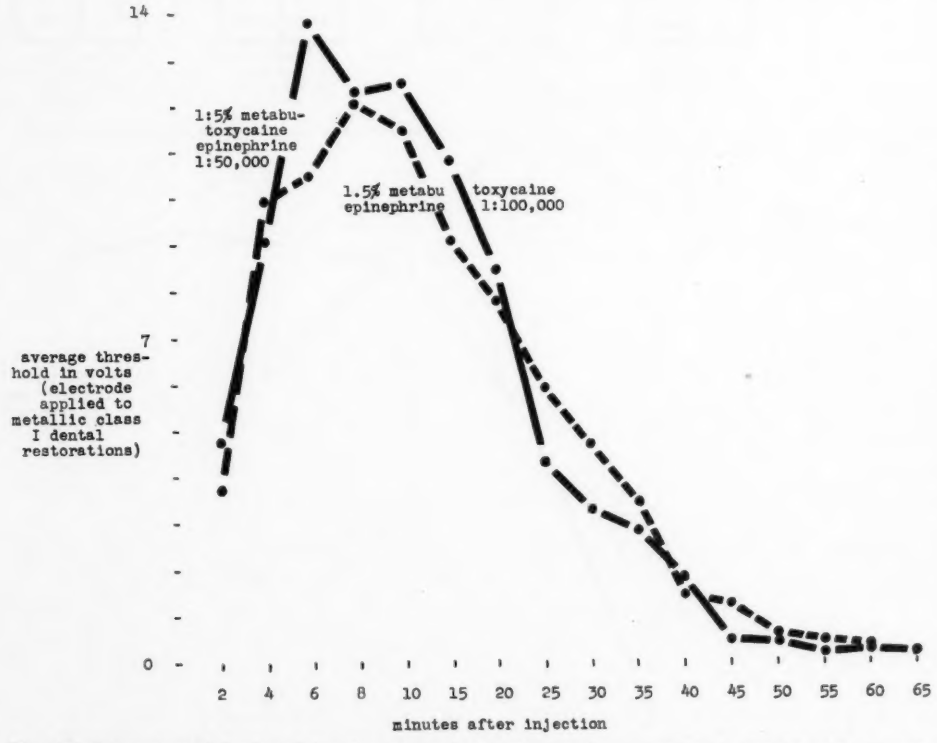

Fig. 10—Comparison of depth and duration of anesthesia using metabutoxycaine hydrochloride with epinephrine 1:50,000 and 1:100,000

dicated pain but not sufficient to warrant reinjection. Finally, Grade C anesthesia was regarded as the type requiring additional local anesthesia. It appeared to him that depth was slightly greater when stronger epinephrine solutions were added to lidocaine. However, this relation was not observed in the metabutoxycaine experiments.

Harris and Worley[8] compared 1.5 per cent metabutoxycaine 1:50,000 epinephrine as against 1:100,000 epinephrine. Infiltration injections were made with 0.5 cc. of the solution. The pain threshold was recorded as the mean quantity of electricity used to elicit pain when applied to a dental metallic occlusal (Class I) restoration. It appears from Figure 10 that anesthetic depth is slightly greater with the 1:50,000 epinephrine solution than with the 1:100,000 solution. Figure 11 shows the results of a similar study with 2 per cent lidocaine and 1:50,000 and 1:100,000 epinephrine. Once again, the more concentrated epinephrine solution produces greater depth.

EXTENT OF ANESTHESIA—Huldt[3] studied the spread of anesthesia under conditions in which only the amount of

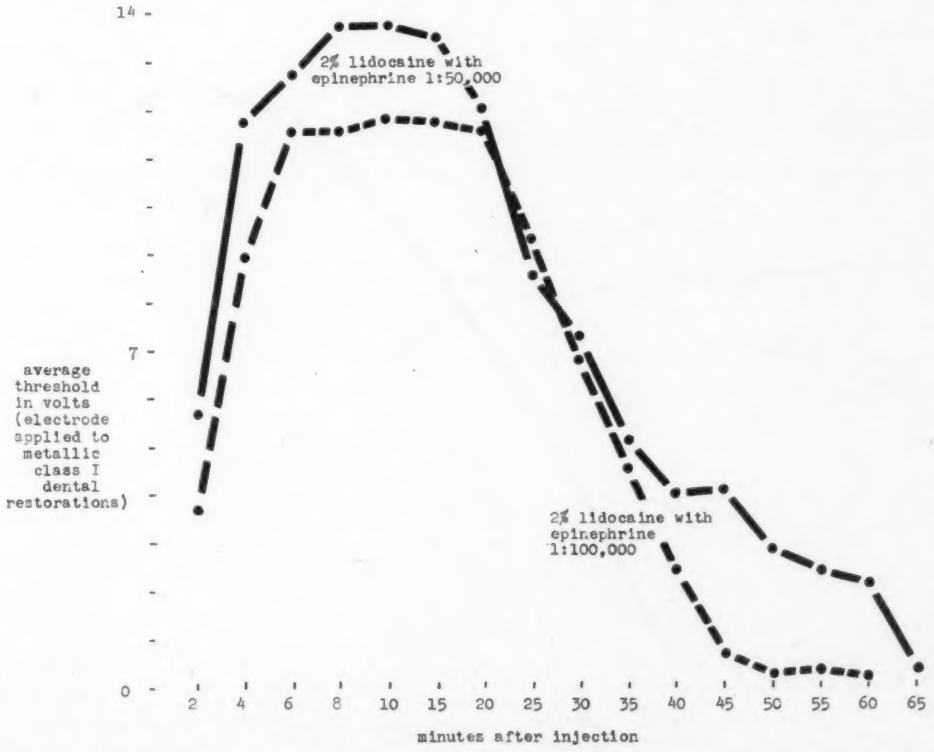

Fig. 11—Comparison of depth and duration of anesthesia using lidocaine hydrochloride with epinephrine 1:50,000 and 1:100,000

epinephrine injected varied. It is clear from Figure 12 that spread increases with increase in epinephrine up to a point.

DURATION OF ANESTHESIA—Huldt[3] investigated length of anesthetic effect by maintaining a constant amount of lidocaine and varying the epinephrine concentration. Figure 13 emphasizes the point that duration increases with increase in epinephrine concentration.

Huldt,[3] using 1 ml. 2 per cent procaine without epinephrine in supraperiosteal injections over maxillary lateral incisors, failed to achieve anesthesia in any of ten test subjects. The addition of epinephrine 1:40,000 to the 2 per cent procaine solution resulted in an anesthesia duration averaging 25 minutes. Put more simply, this experiment suggests that adding a vascoconstrictor substance to a local anesthetic solution produces duration of anesthesia.

Costich[7] studied duration of anesthesia in patients injected with 2 per cent procaine and 2 per cent procaine with 1:50,000 epinephrine. He observed greater duration in the patients who received epinephrine.

Kramer[6] investigated the duration of

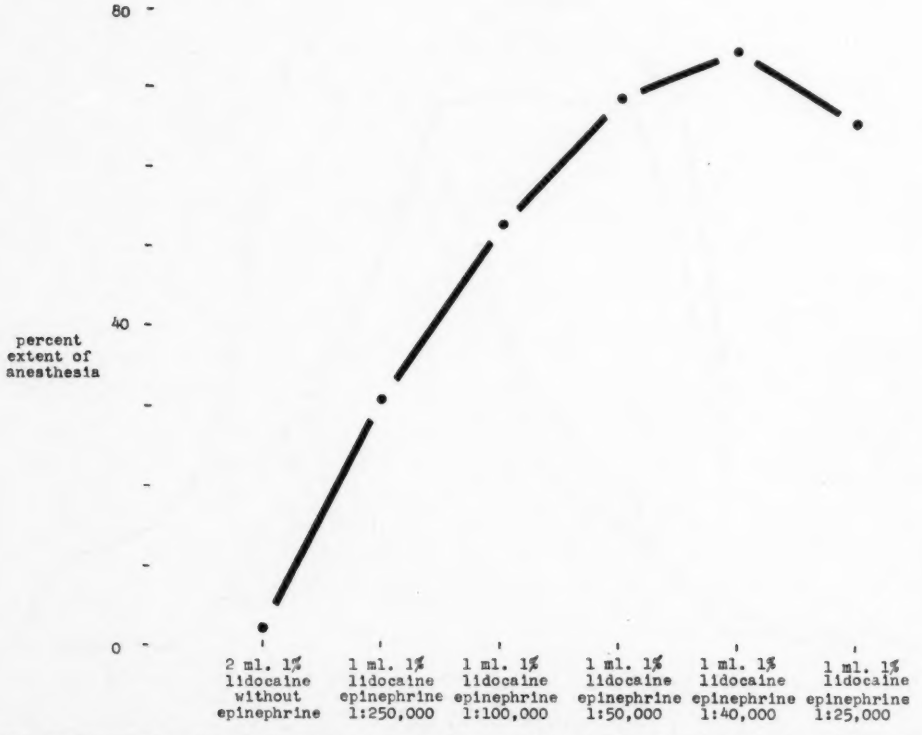
80
40
0
percent extent of anesthesia
2 ml. 1% lidocaine without epinephrine
1 ml. 1% lidocaine epinephrine 1:250,000
1 ml. 1% lidocaine epinephrine 1:100,000
1 ml. 1% lidocaine epinephrine 1:50,000
1 ml. 1% lidocaine epinephrine 1:40,000
1 ml. 1% lidocaine epinephrine 1:25,000

Fig. 12—Comparison of per cent extent of anesthesia versus concentration of epinephrine in a 1 per cent solution of lidocaine hydrochloride

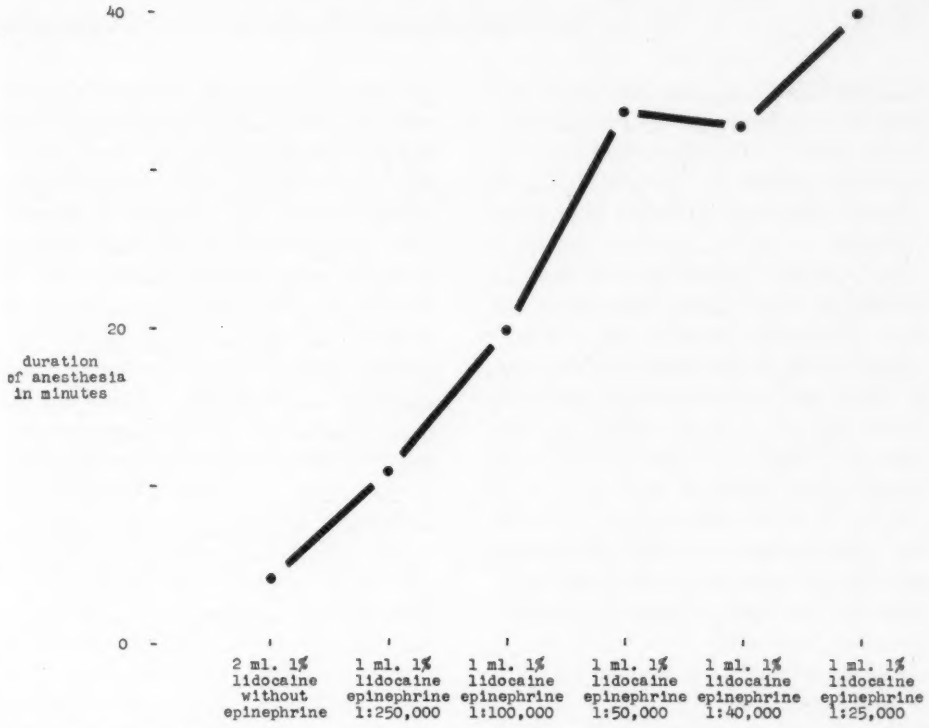
40
20
0
duration of anesthesia in minutes
2 ml. 1% lidocaine without epinephrine
1 ml. 1% lidocaine epinephrine 1:250,000
1 ml. 1% lidocaine epinephrine 1:100,000
1 ml. 1% lidocaine epinephrine 1:50,000
1 ml. 1% lidocaine epinephrine 1:40,000
1 ml. 1% lidocaine epinephrine 1:25,000

Fig. 13—Comparison of duration of anesthesia versus concentration of epinephrine in a 1 per cent solution of lidocaine hydrochloride

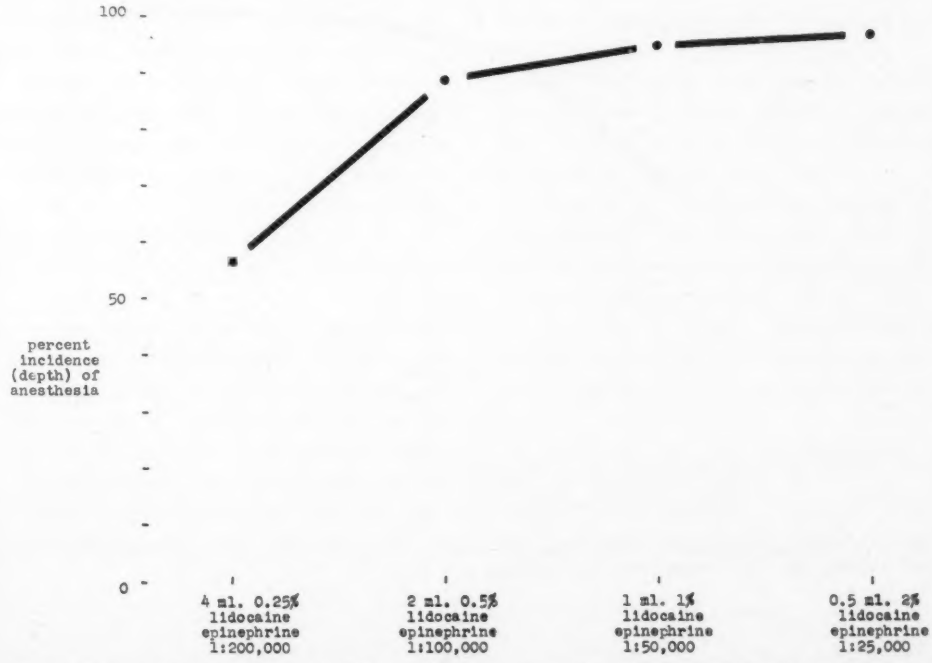
100
50
0
percent incidence (depth) of anesthesia
4 ml. 0.25% lidocaine epinephrine 1:200,000
2 ml. 0.5% lidocaine epinephrine 1:100,000
1 ml. 1% lidocaine epinephrine 1:50,000
0.5 ml. 2% lidocaine epinephrine 1:25,000

Fig. 14—Comparison of incidence (depth) of anesthesia with concentration of a total drug dose of 10 mg. of lidocaine hydrochloride and with 20 micrograms of epinephrine

anesthesia after maxillary and mandibular injections with 1.5 per cent metabutoxycaine and 1:60,000 epinephrine and 1:125,000 epinephrine. He also studied the relative effect of 1:50,000 and 1:100,000 epinephrine with 2 per cent lidocaine. The evidence suggests little, if any, difference due to the additional epinephrine.

Harris and Worley[8] (Fig. 10, 11) show only slight increase in duration with 1:50,000 epinephrine plus lidocaine over 1:100,000 epinephrine and lidocaine. No apparent difference can be observed in the metabutoxycaine series.

SIDE EFFECTS—Costich[7] analyzed the side effects encountered after the injection of 2 per cent procaine as against 2 per cent procaine with 1:50,000 epinephrine. He observed systemic reactions in 2.1 per cent of patients after epinephrine-free injections and side reactions in 15.3 per cent after the injection of procaine with epinephrine. Tremors were observed to be the most common side reaction.

Kramer,[6] in comparing the incidence of untoward reactions (fainting, tremor, postoperative edema, nervousness, pain on injection, and headache) during clinical use of lidocaine 2 per cent with epinephrine 1:50,000 and with 1:100,000 and metabutoxycaine 1.5 per cent with epinephrine 1:60,000 and with 1:125,000 found that the solutions containing the more dilute concentrations of epinephrine produced no untoward reactions when

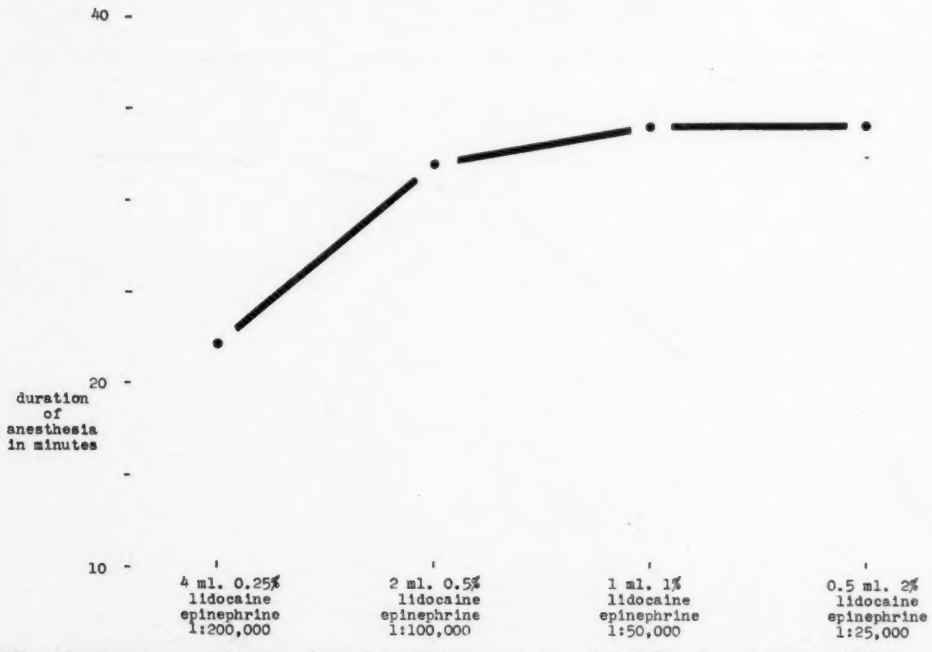
40
20
10
duration of anesthesia in minutes
4 ml. 0.25% lidocaine epinephrine 1:200,000
2 ml. 0.5% lidocaine epinephrine 1:100,000
1 ml. 1% lidocaine epinephrine 1:50,000
0.5 ml. 2% lidocaine epinephrine 1:25,000

Fig. 15—Comparison of duration of anesthesia with concentration of total drug dose of 10 mg. of lidocaine hydrochloride and with 20 micrograms of epinephrine

used in maxillary injections. There was only a small percentage of side reactions when the more concentrated solutions of vasoconstrictors were employed in maxillary infiltrations. In the case of lidocaine used in mandibular blocks, there were fewer untoward symptoms with the use of epinephrine 1:50,000 than there were with the 1:100,000 solution. The converse was true of metabutoxycaine used in mandibular blocks; the more concentrated epinephrine solution produced a greater percentage of reactions than did the less concentrated solution.

■ *Analysis of Combinations of Anesthetics and Vasoconstrictors*

Thus far, consideration has been given to either the local anesthetic solution (with the vasoconstrictor substance constant) or the vasoconstrictor agent (with the local anesthetic substance constant). The evidence shows that each of these two ingredients plays a role in the onset, depth, spread, and duration of anesthesia. However, there is evidence to indicate that addition, antagonism, or synergism may also play a role. Accordingly, consideration will now be given to the studies which deal with combinations of local anesthetic and vasoconstrictor agents and their effect on: (1) depth, (2) extent, and (3) duration of anesthesia.

DEPTH OF ANESTHESIA—Huldt[3] investigated 37 subjects, each injected with 10 mg. lidocaine plus 20 micrograms epinephrine. The variable which was being studied was the total volume of the solution. Figure 14 shows that, as the volume of the solution decreases, the anesthetic depth increases.

EXTENT OF ANESTHESIA—Huldt[3] also analyzed the spread of anesthesia under the conditions just outlined. He observed that, with decrease in volume, there was increase in spread of anesthetic effect.

DURATION OF ANESTHESIA—Huldt[3] also investigated duration of anesthesia. It can be seen (Fig. 15) that, as the total volume of injected solution decreases, the duration increases.

■ *Summary and Conclusions*

An attempt has been made in this report to review the problems of concentrations of local anesthetic solutions and vasoconstrictor substances. Only studies dealing with human beings and those with quantitatable data have been included. The following conclusions are in order:

1. The greater the concentration of local anesthetic solution, the more rapid the rate of the induction, the greater the depth of anesthesia, the more extensive the anesthetic spread, and the longer the anesthesia lasts.

2. Induction time, depth, extent, and duration of anesthesia are enhanced the smaller the total volume of injected solution for a given drug dose.

3. The greater the concentration of vasoconstrictor agent, the more rapid the rate of induction, the greater depth, spread, and duration of anesthetic effect.

4. The evidence, though meager, suggests more side effects when epinephrine is added to a local anesthetic solution.

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The therapeutic use of local anesthesia

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The concept of the use of local anesthesia in the routine prophylaxis of pain must be broadened to include the therapeutic indications as well. Local anesthetics enjoy an expanding scope of usefulness as adjunctive and even curative agents.

Pain is a physiological and psychic phenomenon which has both interested and plagued man since his creation. His earliest attempts to control pain were by physical methods, such as heat, cold, massage, and pressure. During the same period, he also learned of the beneficial effects of psychotherapy and autosuggestion.

Progress was slow in the development of methods of pain control, and it was not until the beginning of the twentieth century that any appreciable progress was made in unraveling the mystery of pain as a neurophysiological process.

Two inventions made possible the initiation of this research and made local anesthesia practical. These were the hollow metal needle introduced by Rynd in 1843 and the metal syringe, invented two years later by Wood in Scotland and Pravaz in France.[1] It is of interest historically that these pioneers directed their original efforts at facial neuralgia.

"The therapeutic use of local anesthesia" may not seem at first consideration to be practical to the general practitioner. It is important, nevertheless, not only for his broader knowledge of local anesthesia but also for a better understanding of the pathologic conditions which are treated.

For the purpose of this discussion, the material has been divided arbitrarily into three categories: (1) the therapeutic use of local anesthesia for conditions in which the control of pain, either directly or indirectly, is the distinguishing feature; (2) conditions in which pain control is not the essential feature and in which properties other than the analgesic properties of local anesthetics are utilized; (3)

conditions in which the therapeutic value lies in topical application of the drugs.

■ *Pain Control*

Conditions in which pain control is the essential feature are the following:

NEURALGIA—The term neuralgia is here defined as paroxysmal or persistent pain in any nerve or group of nerves regardless of the etiology of the disturbance. Diagnostic nerve blocks with local anesthetic solutions are extremely valuable in all types of facial neuralgia. Usually as therapeutic agents they have been ineffective for any appreciable period of time. There have been accounts in the literature, however, in which claims have been made regarding the successful use of local anesthesia even in trigeminal neuralgia. Livingston[2] reported success in four cases after injection directly in the trigger zones. The injections were staggered and averaged four in the cases reported.

When the drugs used for diagnostic purposes seem to be effective for periods longer than expected, it would appear that reinjection on subsequent days or at longer intervals would be indicated.

In good-risk patients with major facial neuralgia in whom diagnostic blocks have definitely located the nerve or nerves involved, neurosurgery is probably the treatment of choice. Ethyl alcohol injections afford only temporary relief, although this procedure permits the patient to experience the numbness which is a permanent symptom after surgery. Alcohol injection has the disadvantage of allowing the loss of valuable time and if surgery is selected at a later date, the patient frequently has deteriorated from both a physical and mental standpoint.

For other minor and atypical facial neuralgias, local anesthesia is of little value except in diagnosis. Often, however, dental, paranasal and orbital pathologic conditions can be diagnosed and eliminated, thus effectively treating the source of the neuralgia.

In one condition, sphenopalatine ganglion neuralgia, also known as Sluders neuralgia[3] and lower half headache, cure often can be achieved after application of 10 per cent cocaine, or 2.0 per cent tetracaine hydrochloride transnasally to the sphenopalatine ganglion.

MUSCLE SPASM—Spasms of the individual muscles of mastication are rather infrequent, but when they do occur and are not caused by infection, they often can be treated effectively with one or two injections of lidocaine or procaine directly into the muscle. Analgesic blocking agents can be very effective in interrupting the familiar "pain-spasm-pain" cycle.[1]

The more complicated muscle spasm of the temporomandibular joint syndrome is more of a problem to the practicing dentist. With the gradual recognition by the profession that the etiology of this syndrome often lies in the malocclusion of the teeth, early definitive therapy is now directed toward bite correction rather than to the painful spasm.

Long-acting oil-base analgesic drugs have been advocated for the treatment of temporomandibular joint disorders. Enthusiasm has waned, however, because of the many complications which include abscess, skin sloughs, and occasionally a prolonged tenderness over the injection site.

Fig. 1—Side view of the patient in spasm. Note strained, inframandibular musculature

DISLOCATIONS OF MANDIBLE—Dislocations of the mandible usually are attended by spasm of the temporalis, masseter and the pterygoid muscles. A relatively new and as yet to be evaluated clinical finding was recently reported by Johnson.[4] He was treating the pain associated with a dislocation prior to reducing it. After bilateral injections of the joints, automatic reduction occurred and later it was found that reduction occurred after unilateral injection. This interesting observation may lead to a better understanding of the pathologic physiology of temporomandibular joint dislocation and its attendant muscular spasms.

A most unusual and distressing case was recently referred to the National Institute of Dental Research. The patient began having recurrent temporomandibular dislocations five years ago, and has now developed a syndrome which is no longer one of dislocation but is now a severe spasm of all of the submandibular musculature including both the infrahyoid and suprahyoid groups (Fig. 1, 2). This spasm is so strong that it taxes the strength of an adult man to reduce it and the patient weighs less than 80 pounds. Bilateral injections of the joints have relieved this spasm for short periods of time, which suggests an abnormal trigger mechanism operating in the region of the glenoid fossa. Since studying this case, I have wondered whether the submandibular musculature is involved to a degree in all dislocations.

SYSTEMIC AILMENTS — Local anesthetic solutions have been given intravenously for the treatment of a large group of systemic ailments. A few of these will be mentioned briefly for academic rather than practical reasons, since their use is medical rather than dental.

The effectiveness of procaine, tetracaine, lidocaine, and other analgesic agents to relieve the pain associated with severe burns, arthritis, generalized inflammation and spasms, and the pruritis in certain allergic conditions, has been proved in clinical practice.[5]

■ *Other Properties*

Local anesthetics have been used in conditions in which pain has not been an essential feature. In addition to their analgesic properties, local anesthetics possess other properties which make them valuable when used therapeutically in specific

conditions. The local and general vasodilative capacity of certain anesthetics has made them particularly useful.

POSTOPERATIVE COMPLICATIONS — Many oral surgeons and practitioners of dentistry are using intravenous barbiturates, both for sedation and for general anesthesia. When accidental extravenous leakage of these barbiturates occurs, a painful arm is certain and necrosis has been known to occur. Procaine (2 per cent), with or without hyaluronidase, injected into the area of leakage is a useful prophylaxis against these postoperative complications. Procaine is effective under these circumstances, both as a diluent, and because of its known vasodilative effect. Furthermore, the acidity of procaine helps to neutralize the alkaline barbiturate.

CONTROL OF HEMORRHAGE — Local anesthetic solutions are often used therapeutically to help control hemorrhage during general anesthesia. This effect is mediated both by the vasoconstrictor substances contained in the anesthetic solution and by the local pressure exerted by the solution injected. This valuable technic can be used effectively in many types of oral surgery.

Although separate from this discussion, I wish to mention the supportive use of local anesthesia in the control of any postoperative dental hemorrhage.

Three factors are important when dealing with dental hemorrhage: immediate good local anesthesia, good light, and good suction. This is indirectly therapeutic, but of sufficient importance to accentuate.

■ *Topical Application*

The principal consideration when topical application is used therapeutically should be the realization by the dentist that after topical application there is rapid absorption into the systemic circulation. It is important, then, that he considers the amount of the drug used, its relative toxicity and absorption, as well as possible allergic and hypersensitivity reactions. Campbell and Adriani[6] have reported recently that absorption was as rapid after topical laryngeal application as after intravenous injection of many of these drugs, and that pharyngeal absorption was almost as rapid. They also reported that in abrasions, burns and similar conditions in which the skin and mucous membranes

Fig. 2—Front view of patient in spasm

were broken, high blood levels were attained rapidly.

The topical anesthetics come in many forms, such as ointments, creams, liquids and sprays. The form should be chosen which allows for the best contact of the drug to the area and which also insures minimal systemic absorption.

Some of the conditions for which dentists employ topical anesthetics are:

1. For painful oral ulcerations, such as occur in aphthous and herpetic stomatitis.
2. For pain in the stomatitides of pemphigus, leukemia, erythema multiforme and periadenitis mucosa necrotica recurrens.
3. For pain due to osteoradionecrosis and oral carcinoma.
4. In the "learning-to-use" stage in complete denture prosthesis.
5. To drain superficial abscesses.
6. To extract loose deciduous teeth.
7. To scale sensitive teeth.
8. For preinjection desensitization of the mucous membranes.
9. To control gagging during impression taking and for obtaining roentgenograms.

The drugs which have been most widely used in topical preparations have been lidocaine, tetracaine, benzocaine, and benzyl alcohol.

A study of recurrent aphthous stomatitis and related oral conditions is in progress at the Clinical Center and affords an ample opportunity to observe and treat many painful oral conditions. In addition, the patients of the surgical, chemotherapy and radiation branches of the National Cancer Institute have particularly painful oral problems.

During the past two years, investigators[7] at the Clinical Center have studied various antihistamine drugs and have found that a solution of 0.5 per cent dyclonine and 0.5 per cent diphenhydramine hydrochloride in normal saline solution is a highly effective topical anesthetic with a very low toxicity. Because of its relatively low toxicity it has been used liberally in some of our patients who, because of the number or severity of their lesions, were liable to toxic absorption.

■ *Summary*

Local anesthetics can be used therapeutically as follows:

1. For conditions in which pain control is the distinguishing feature such as in the treatment of neuralgias, muscle spasms, dislocations, burns, arthritis and other systemic conditions.
2. For conditions in which pain control was not essential such as extravascular leakage, hemorrhage, and other conditions affected by other than anesthetic properties.
3. Finally, these drugs can be applied topically. A new highly effective antihistamine combination of low toxicity has been investigated.

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*Chief, oral surgery section, National Institute of Dental Research.

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Methohexital sodium anesthesia for oral surgery

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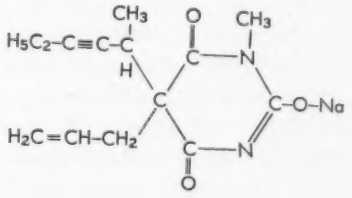
Many of the problems which confront the oral surgeon who uses intravenous barbiturate anesthesia for ambulatory patients are solved in part with the introduction of an oxybarbiturate agent. In clinical trials methohexital reduces recovery time and allays postoperative nausea. Hiccough occurred infrequently (3 per cent); laryngospasm even less often. Methohexital is more potent milligram for milligram than are previously used thiobarbiturates. On the whole, undesirable side effects are seldom seen with this agent and it appears to be of definite value in a busy oral surgery practice where recovery time is a major factor.

Intravenous barbiturate anesthesia is firmly established in many oral surgery practices as the principal method of general anesthesia. Some of the problems encountered with the intravenous method have been recovery time control, nausea and postoperative emotional disturbances. Methohexital sodium has characteristics which overcome some of the problems encountered with other intravenous barbiturates. Methohexital sodium is reported to be more potent, briefer in action, and more rapidly detoxified than the other available intravenous barbiturates.[1]

Methohexital sodium is an oxybarbiturate rather than a thiobarbiturate. The two asymmetric carbon atoms which are present allow the formation of two pairs of isomers, and the -dl pair is the one used as an intravenous anesthetic. The pH of a solution of methohexital sodium is approximately 11.0, the same as other barbiturate solutions, and, therefore, should not be mixed with acid solutions such as atropine sulfate, dimethyl tubocurarine iodide, and succinylcholine chloride.

The structural formula for methohexital sodium is as follows:



■ *Description of Study*

A study was made of 2,500 instances of anesthesia for oral surgical procedures. Methohexital sodium (Brevital), 1 per cent solution, was used as the principal medication was used. Oxygen was used anesthetic agent in all instances. No pre-

on all patients with reduced functional reserve due to cardiovascular disease (6.2 per cent). Nitrous oxide plus oxygen (25 per cent) was used for preinduction for children and those in their early teens. Nitrous oxide plus oxygen (50 per cent) was used as a preinduction agent for the very elderly and debilitated patients.

Anesthesia time was recorded as the interval from the start of injection to the completion of the surgical procedure. The recovery time was measured from the completion of the surgical procedure to the time the patient was dismissed from the office. Induction doses, total doses, reactions during and after the surgical procedure and the patients' opinion as to how they felt during recovery were recorded.

The intermittent surge technic of administration was used.[2] A deep reclining chair position was used for all patients. The time of operation (anesthesia time) varied from less than ½ minute to 35 minutes. The induction dose was calculated to produce a working level of anesthesia. It was given rapidly. The induction dose varied from 10 to 150 mg. (1 to 15 cc.); the average for all instances was 84 mg. (8.4 cc. of 1 per cent solution). The required dose varied more with patient nervousness than with patient size. Minimal doses were required for those in the extremes of age and for the very obese. Additional intermittent doses were given only as required and in many instances were dictated by the patient's muscular or vocal response to stimuli. For longer procedures requiring more than an induction, the total dosage varied from 100 to 500 mg. The average total dose for these instances was 190 mg. (19 cc. of 1 per cent solution).

Optimum maintenance doses were about half of the induction dose until two or three doses had been given, then there was some evidence of cumulation and a third of the induction dose was used to re-establish surgical levels of anesthesia.

Children were given preinduction doses of nitrous oxide and oxygen (25 per cent), after which small doses (10 to 30 mg.) of methohexital sodium provided smooth induction and maintenance with nitrous oxide and oxygen mixtures containing a relatively high proportion of oxygen.

The very elderly and infirm patients were given preinduction doses of nitrous oxide and oxygen (50 per cent), followed by small induction doses of methohexital sodium (10 to 50 mg.). This combination produces a very light amnesia-anesthesia state with practically no drug depression. This level could be prolonged with very small intermittent injections of methohexital and nitrous oxide plus oxygen (50 per cent). Recovery was immediate, and these patients were uniformly pleased.

■ *Reactions During Surgery*

Relaxation was inadequate in 2 per cent of the instances of anesthesia. The resistive patients were given meperidine hydrochloride (Demerol), nitrous oxide and oxygen, and subapneic intermittent doses (10 to 15 mg.) of succinylcholine chloride.

Partial laryngospasms were encountered in ten instances and complete laryngospasms in five instances. Both the partial and complete laryngospasms were readily relaxed with intravenous injections of 10 mg. of succinylcholine chloride.

Hiccough occurred in 3 per cent during surgery. Most patients hiccoughed only once or twice, and none more than 15 times. Muscular twitching occurred about the eyes in some instances. This reaction appeared more frequently when small doses were repeated to achieve a working level of anesthesia and less frequently when surge inductions were adequate to produce immediate surgical levels of anesthesia.

No vomiting occurred during anesthesia; gagging occurred in only 1 per cent. In 1 per cent of the instances, coughing occurred.

■ *Recovery Period*

Recovery time varied greatly, as the interval was measured from completion of surgery to actual dismissal from the office. The need to keep patients until hemostasis was assured accounted for most of the recovery time recorded for short procedures. It is noteworthy that in the longer surgical procedures where relatively larger total dosage was used, only slightly longer recovery time was recorded than for the shortest procedures. Patients required as much supervision as they would if a thiobarbiturate had been used, because they felt so normal that they would wander about the office or dismiss themselves.

■ *Reactions During Recovery Time*

Patients were alert without inebriation or dizziness in most instances (82 per cent). Postoperative nausea was encountered in 11 instances (0.4 per cent). This was a transitory reaction and lasted only a few minutes. A similar survey with a thiobarbiturate using the same methods showed an incidence of nausea of 6.8 per cent.[3] Vomiting was absent in all instances. Crying during the recovery period occurred with 15 per cent of the patients. Patients were inclined to be apologetic rather than complaining because they felt weepy. Two patients were belligerent for a few minutes.

The following reactions also were noted during the recovery period: laughing, 0.3 per cent; restlessness, 1 per cent; dizziness, 1 per cent, and postoperative pain on awakening, 0.25 per cent.

The patients' evaluation of their reactions on awakening were as follows: normal, 93 per cent; happy, 0.4 per cent; sad, 6 per cent; depressed, 1 per cent; belligerent, 0.2 per cent; complaint of pain during surgery, 0.3 per cent, and complaint of vein irritation, 0.1 per cent.

Many patients complained of feeling nervous, and four patients exhibited severe anxiety. In such instances relief was obtained with 10 mg. of prochlorperazine (Compazine) or 25 mg. meperidine hydrochloride. At the beginning of this study several patients were dismissed without treatment for this anxiety state. Three of these were sleepless and extremely nervous for two days. Pentobarbital sodium (Nembutal) ¾ grain given every four hours as needed was effective in controlling the nervous state in one to four doses. It was noted that this postanesthesia anxiety sometimes occurred when the surgical procedure was carried out with the patient at amnesia or waking levels of anesthesia. By deepening the level of anesthesia in the last 1,000 instances in the study, it was possible to avoid all but a few mild nervous reactions.

■ *Discussion*

Signs of anesthesia occurred after the initial injection in the usual arm-to-brain circulation time. This was about 12 seconds in average subjects.[4] The full depth of anesthesia occurred approximately 15 seconds after the first signs of anesthesia. The time interval between subsequent intermittent maintenance doses varied widely, because about half of the patients would tolerate surgical procedures after the induction dose was apparently completely spent and the patient appeared to be awake. A few patients reported feeling the surgical procedure but none complained of feeling pain. There appeared to be an effective amnesia carry-over after patients were awake. A few resistive patients were encountered (3 per cent) in whom twice the anticipated dose did not produce sufficient anesthesia and relaxation for surgery. In these instances meperidine hydrochloride, nitrous oxide plus oxygen and subapneic intermittent doses of succinylcholine chloride were used to produce the necessary relaxation. These resistive patients would not tolerate surgical stimuli while in light anesthesia levels.

Very apprehensive patients required 25 to 50 per cent more methohexital sodium than patients of the same age and size who were calm.

■ *Summary*

A survey of instances of methohexital sodium anesthesia for oral surgery, has been made. Laryngospasms were infrequent and mild. Most patients tolerated surgical procedures in very light planes of anesthesia with the swallowing, cough and gag reflexes active. These light anesthesia levels facilitated the protection of the airway and minimized drug depression. Recovery time is considerably reduced with methohexital sodium. Minimum postoperative nausea occurred and no vomiting was observed. A few patients were euphoric and a few were sad on awakening; however, most patients felt normal without feeling drunken or dizzy. Crying was observed during the recovery stage in a small percentage of patients. A few resistive patients required supplemental medication for relaxation. Postanesthesia nervousness was occasionally encountered when the surgical procedure was carried out with the patient at amnesia levels.

■ *Conclusion*

In my experience methohexital sodium is a superior intravenous barbiturate anesthetic for the ambulatory oral surgery patient. The problems of recovery time and postoperative nausea appear to be greatly reduced with this drug. The lighter planes of anesthesia with active protective reflexes which are possible with methohexital sodium make this a safer general anesthetic agent for oral surgery. —*123 Atlantic Avenue.*

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Intravenous premedication in dentistry

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The agitated and fearful patient usually needs assistance to withstand the emotional stress of dental procedures. The following is a preliminary report of 4,800 cases in which intravenous administration of drugs was used to allay the fears of the patient. Various short-acting barbiturates, alone and in conjunction with meperidine hydrochloride, morphine sulfate or atropine sulfate, were used as the premedicating agents. Local anesthesia was employed, and the procedures included most types of minor oral surgery as well as crown and bridge procedures. Both the patients and the professional staff have shown excellent acceptance of this technic.

Fear grips many persons when they anticipate a dental operation. The fear of pain, of tissue damage from a momentarily uncontrolled instrument, and of the unknown elements constitutes a mental and physical hazard.

Additionally, many dental procedures are, to a varying degree, uncomfortable or painful. Such routine procedures as deep cavity preparation, crown and abutment preparations with attendant abrasive and vibratory sensations, needle insertion, and matrix band placement stimulate many patients most unpleasantly.

From the operator's viewpoint, the hyperreactive, apprehensive patient producing copious amounts of saliva, or the patient who occasionally faints or becomes completely uncontrollable at the thought of a given dental procedure, is conducive to neither the best efforts nor best results.

Recently inducted young airmen could reasonably be expected to exhibit fear reactions when reporting for dental treatment. These men have been uprooted from their familiar environment, and are undergoing physical and mental trauma of varying degree while adjusting to military life and intensive training activities.

Syncope is seen frequently among these men. True hysteria also has been observed. Occasionally a patient vomits. Many have become nauseated. One or two have urinated or defecated on receiving local anesthesia or at the beginning of surgery.

During a survey period, about 12.5

per cent of the outpatients admitted to the oral surgery service of Lackland Air Force Base, Texas, evidenced some obvious reaction during their treatment, such as gasping, syncope, dizziness, nausea, and vomiting.

There have been two instances in this service of proved allergy to a local anesthetic agent.

■ *Project Analysis*

In an effort to overcome such problems, the oral surgery service of Lackland Air Force Hospital began in May 1956 a project designed to develop a safe, easy, practical premedication procedure that would not consume too much of the doctors' or patients' time. In addition to basic airman trainees, the study included a number of female dependents.

Some 43,000 surgical procedures are completed yearly by this oral surgery service. The majority of procedures are performed on basic airmen trainees with a special need for a type of medication the effects of which would be dissipated quickly and the patients returned to their training area in full control of their faculties.

Oral premedication was considered, but discarded for the time being. The presence or absence of fear and thus uncertain peristalsis; the presence or absence of a food bolus; the pH of duodenal contents—all these factors militate against absorption of orally administered drugs with any degree of certainty or speed. This does not preclude the oral administration of premedicants under certain conditions, but for general usage, this procedure is considered to have many undesirable aspects.

Although intramuscular medication could be used, the effects cannot be immediately assessed. Furthermore, the recovery time appears to be prolonged in most instances. Again, these considerations do not preclude intramuscular premedication under certain conditions.

Intravenous medication was selected for the preliminary study because effects could be evaluated immediately and, generally, these effects would more quickly "wear off" than with other methods.

After premedication, operations were performed with patients under local anesthesia, using lidocaine 2 per cent with epinephrine 1:50,000. Most of the patients were young basic airmen 17½ to 22 years of age. Operations ranged from single tooth extractions to full-mouth odontectomies, removal of roots in the antrum, incision and drainage, correction of dislocated jaws, and crown and bridge procedures.

This report is based on clinical experiences in more than 4,800 patients.

■ *Drugs Studied*

For the preliminary study, the following drugs and combinations were used:

1. Pentobarbital sodium (Nembutal Sodium) alone.
2. Secobarbital sodium (Seconal Sodium) alone.
3. Secobarbital sodium with meperidine hydrochloride (Demerol Hydrochloride).
4. Secobarbital sodium with morphine sulfate and atropine sulfate.
5. Thiopental sodium (Pentothal Sodium) with morphine sulfate and atropine sulfate.

The pharmacology of these drugs is so well known that no review is repeated.

■ *Clinical Results*

PENTOBARBITAL ALONE—Pentobarbital sodium was used alone for premedication in 75 instances. Doses ranged from 100 to 200 mg. with the average dose being 145 mg. Patients' weight spread was from 114 to 200 pounds.

All patients who had prior dental treatment without any sedation preferred this method of medication.

The doctors considered the effect of the sedation on the patient during the operating period satisfactory. However, the doctors agreed that these patients seemed to require a long recovery period in the clinic after pentobarbital sodium medication. All patients were kept in the clinic until able to walk back to their training area in full control of their faculties. The time varied from one to three hours.

SECOBARBITAL ALONE—Secobarbital sodium, alone, was used for premedication in 117 instances. The dose ranged from 50 to 100 mg., the greater portion being 50 to 75 mg. The average dose was about 67 mg.

Patients receiving secobarbital sodium premedication were satisfied. Doctors considered the patient acceptably sedated during the working period.

A comparison of the effect of the two barbiturates indicated that the group sedated with secobarbital sodium alone were alert sooner than those patients given only pentobarbital sodium. However, the average dose of pentobarbital was two times as large as that of secobarbital. No explanation is attempted as to whether this increase was necessary to achieve equivalent patient sedation, or whether greater clinical experience caused a modification of the dosage. Both barbiturates are considered short acting.

As expected, gag reflex was not obtunded with either drug, nor was salivary flow suppressed. Both factors were considered disadvantageous.

SECOBARBITAL WITH MEPERIDINE—A combination of secobarbital sodium and meperidine hydrochloride was used in 150 patients. Of these, 134 were given 50 mg. of each agent. However, one patient, age 20, weight 148 pounds, was referred to this clinic because he had a history of "fainting whenever he had any 'minor' oral surgery" and was exceedingly apprehensive when he came for treatment. He was given 250 mg. secobarbital sodium with 50 mg. meperidine hydrochloride. This treatment proved most successful. The patient was fully oriented in the same period as other patients receiving smaller doses at the same time that day. This and other instances strengthen the postulate that the dosage should not be completely standardized.

Patients who had received all three of these types of medication prior to oral surgical procedures voluntarily expressed greater satisfaction with the latter combined premedication than with either of the single barbiturates. These patients also volunteered the information that they felt less "groggy" than the "last time."

A patient who had warned that he "always came up fighting after fainting in the dental chair" had extractions at the Lackland clinic on two different occasions

with the secobarbital-meperidine combination with no untoward results.

Doctors thought they detected somewhat less saliva than when using barbiturates only. None rated the combination treatment unsatisfactory. All considered it superior to the use of barbiturate alone. Gag reflex was observed to be slightly obtunded.

SECOBARBITAL WITH MORPHINE AND ATROPINE—A combination of secobarbital sodium, morphine sulfate and atropine sulfate was used in over 4,500 patients. Most of the patients in this group, as outpatients, were given 50 mg. of secobarbital and ⅛ grain (8 mg.) morphine sulfate with 1/300 grain (0.2 mg.) atropine sulfate. Most inpatients received 75 mg. secobarbital with ⅛ grain morphine and 1/225 grain (0.275 mg.) atropine. One extreme of dosage was an instance in which 300 mg. of secobarbital with ¼ grain (16.2 mg.) morphine and 1/150 grain (0.432 mg.) atropine was administered; the other extreme instances were of young, healthy basic airmen to whom 25 mg. secobarbital with ⅛ grain morphine was given.

After receiving secobarbital-morphine-atropine premedication, patients expressed satisfaction.

Notable advantages over the preceding types of premedication from the doctors' standpoint were the elimination of saliva and the obtunding of the pharyngeal reflexes. These reactions were suppressed sufficiently to allow easy placement of packs and to permit the taking of impressions.

Included in the group receiving secobarbital-morphine-atropine was a group in a pilot study on premedication for crown and bridge operations. Some 50 patients have been managed under similar premedication. Procedures on these patients included three to six-unit bridge abutment preparations, six jacket crown preparations on one patient during a single appointment, and effective treatment of patients who gagged easily. The average dosage was 50 mg. secobarbital with ⅛ grain morphine and 1/300 grain atropine. Patient and doctor acceptance was excellent.

THIOPENTAL WITH MORPHINE AND ATROPINE—Thiopental sodium-morphine sulfate-atropine sulfate in combination was administered preoperatively in more than 500 instances. The thiopental sodium is made up in 4 per cent solution and is usually given in 80 mg. doses with morphine ⅛ grain and atropine 1/225 grain. Generally used in operative procedures of "intermediate length" (approximately 30 minutes), it was used also in one hour procedures as well as 15 minute procedures. Patient and doctor acceptance was excellent.

OTHER TYPES OF PREMEDICATION—Modification of the preceding types of premedication included the use of thiopental sodium alone and the addition of diphenhydramine hydrochloride (Benadryl Hydrochloride) to a barbiturate-morphine-atropine combination.

Thiopental alone in doses ranging from 80 to 100 mg. was used for sedation in some instances of single extraction. Rapid recovery of all faculties was noted. The sedation obtained was considered excellent by patients and doctors.

Diphenhydramine 20 mg. was administered intravenously in addition to the barbiturate-morphine-atropine combination in five instances in which "allergy" was suspected.

Patients stating that they had an allergy to procaine were given skin sensitivity tests. Skin tests for procaine and lidocaine sensitivity were negative in four instances. In one patient the skin test showed a severe procaine sensitivity, but nasal drops of procaine showed no significant changes in blood pressure. Lidocaine anesthesia was used in these five patients.

None of these patients evidenced an untoward reaction of any kind to the lidocaine anesthesia or surgery after diphenhydramine-secobarbital-morphine-atropine premedication.

There have been ten instances of postoperative nausea attributed to morphine. This condition has been treated successfully using diphenhydramine, 20 mg. intravenously, followed an hour later by meclizine hydrochloride (Bonamine Hydrochloride) 25 mg. orally at four hour intervals, for a total of three doses. Noticeable relief from nausea was observed within five minutes after the diphenhydramine injection. The meclizine, given orally, then was able to be retained and absorbed, giving continued protection against morphine nausea.

■ *Equipment and Supplies*

The procedure for handling equipment was developed so that a minimum of work with maximum patient care resulted.

At first, syringes and needles were cleansed in water immediately after use, placed in a blood solvent detergent for a sufficient time to dissolve any remaining blood, rinsed again, and then placed in syringe canisters and autoclaved according to standard procedures.

Experience showed that immediate thorough cleansing in running tap water prior to autoclaving gave good results and eliminated the necessity for the blood solvent detergent and rerinsing.

In some 40 instances premedicant solutions were prepared in the clinic using the ¼ or ⅛ grain tablet of morphine and 1/150 grain tablet of atropine. The need for sterile distilled water, the inconvenience, and the possibility of contamination led to the definite adoption of a ready-prepared solution in multiple-dose vials.

Secobarbital (Seconal) is supplied in 20 cc. multiple-dose ampules which contain 50 mg. of secobarbital per cubic centimeter. Morphine and atropine are obtained in 20 cc. multiple-dose ampules containing ¼ grain of morphine and 1/150 grain of atropine per cubic centimeter. Morphine and atropine are available in separate vials if desired.

The advantages of this kind of packaging are sterility, convenience and accuracy of dosage. The ready-prepared solutions are relatively economical.

■ *Method of Administration*

The barbiturate is given first whenever a combination of drugs is administered, because any tendency to nausea from morphine is lessened by giving the barbiturate first. The injection, of course, is made slowly. During venimedication the patient is constantly reassured by the doctor.

One factor is emphasized: Although

two syringes are used in administering the premedicant, only one venipuncture with a 23 gauge needle is made. The barbiturate is given first, as previously stated. This syringe is disengaged from the needle; then the syringe containing morphine is attached and its contents administered. By the use of two syringes, cross mixing of solutions and precipitation is avoided.

In the few instances in which an antihistamine was used, three syringes were utilized with only one venipuncture. In such instances, the order of administration was (1) antihistamine, (2) barbiturate, (3) morphine-atropine mixture.

■ *Summary and Conclusions*

This is a preliminary report on a study designed to determine any advantages and the practicality of intravenous sedation of dental patients.

The methods reported have been used successfully in approximately 4,800 instances during the period from May 1956 through February 1958. In this series, no premedicated patient has exhibited fainting or other untoward reaction during anesthesia and surgery. As a contrast, some 12.5 per cent of unpremedicated patients exhibited reactions. Patient and doctor acceptance of intravenous premedication has been excellent.

Further investigation is being made to determine the "ideal" premedication. In the preliminary study, the most satisfactory combination of drugs proved to be secobarbital sodium-morphine sulfate-atropine sulfate for longer operations, and thiopental sodium-morphine sulfate-atropine sulfate for shorter procedures.

From extensive experience in teaching dental officers these technics, the authors recommend emphatically that practitioners pursue a properly directed short postgraduate course of instruction under the auspices of an accredited dental school before practicing this type of medication.

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■ Standard for Survival

Increase in man's knowledge does not mean the discovery of new things, but only the extension of his understanding and ability to use that which already is, and has ever been. Like the growth of a child from infant to adult, man is discovering worlds new to him, but old to God.

When this is fully realized and accepted, and only then, man can stand straight and tall, assured and certain, in the face of troubled waters and howling winds, of change and apparent uncertainty, of lightning move from success to failure, from ease to difficulty, secure in his knowledge of the way to home port—at peace with himself because he is at peace with Almighty God. This, then, is the final and indispensable "standard for survival."—*Major General J. B. Medaris, The Magazine of Standards.*

Hemorrhagic responses before and after adrenochrome monosemicarbazone sodium salicylate and placebo in dogs

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Previous reports in the literature have suggested that carbazochrome salicylate (Adrenosem) is effective in promoting hemostasis systemically. Dogs were utilized in a double blind study of bleeding induced by tooth extraction. Both the shed volume of blood and bleeding times were recorded carefully under controlled conditions. Results of the preliminary study revealed no appreciable difference in the shed blood volumes or bleeding times between the medicated and the control groups.

There have been several reports on the hemostatic effects of carbazochrome salicylate (Adrenosem).[1-11] All suggest that carbazochrome salicylate therapy is effective in promoting hemostasis after a variety of operations. Without exception these writers have based their conclusions on observations which followed the clinical use of the drug. None has reported the use of controls in their studies nor was the discussed drug compared with other hemostatic agents or placebo. Although these studies represent a pioneering effort to evaluate the hemostatic effect of a new drug, statistical evaluations were not available.

The observation that the intravenous injection of small doses of epinephrine resulted in a shortening of the bleeding time in rabbits prompted Derouaux and Roskam to conduct further investigation on the hemostatic activity of sympathomimetic compounds. It was found that with rare exceptions all sympathomimetic amines shortened the bleeding time when given intravenously in appropriate doses. This effect was not immediate but could occur any time from 15 minutes to six hours after the injection of the amine.[11]

The oxidation of epinephrine produced a substance which Green and Richter named adrenochrome, a highly unstable compound that had prompt hemostatic activity and was without other of the sympathomimetic properties of epinephrine.[12] The instability of adrenochrome prevented its clinical application; however, it was found to react with semicarbazide to produce a more stable compound, adrenochrome monosemicarba-

zone. This preparation was found to be poorly soluble in water, but when combined with sodium salicylate produced a more satisfactory solution, adrenochrome monosemicarbazone sodium salicylate with the ratio of sodium salicylate to adrenochrome semicarbazone being 25:1.[13] Tullar[14] believes this ratio insures against crystallization of semicarbazone at room temperatures.

According to published reports,[2, 5, 9, 13] carbazochrome salicylate is a systemic hemostatic drug which reduces hemorrhage by decreasing capillary permeability and promoting retraction of severed capillary ends. The exact mechanism of this action is not understood in detail, but it has been postulated that carbazochrome salicylate restores tone to the weblike substance connecting the individual cells that form the capillary wall.[9]

Although related to epinephrine, carbazochrome salicylate has no pressor or depressor effect on the blood pressures of anesthetized dogs previously shown to be measurably sensitive to epinephrine.[14] It is nontoxic, has a high index of therapeutic safety,[3] and patients who have been treated for 18 months demonstrated no toxic effects attributable to the drug.[11] Intramuscular injections produce a stinging sensation and local tissue destruction has been noted.[14]

Carbazochrome salicylate is rapidly oxidized in the body and is eliminated within a 12 hour period, mostly through the urine.[9] It should not be administered intravenously since it is a hypertonic solution and has a tendency to cause agglutination of the blood cells.[3] It does not affect blood chemistry or interfere with coagulation or vasomotor response.[15]

In a search of the literature no articles were found which failed to claim some reduction in hemorrhage with the use of carbazochrome salicylate. However, in conversations with hematologists and oral surgeons vitally concerned with this problem, some uncertainty about the reported advantages has been indicated.

Perkins[13] conducted a clinical study on carbazochrome salicylate with 22 of 24 patients showing smaller blood losses after the administration than were observed after similar procedures without the drug. This study also suggested the bleeding time was reduced in 22 of 25 patients after the use of carbazochrome salicylate. Unfortunately, a statistical analysis was not included so that the significance of these values could not be established by the reader.

With these observations in mind the present study was made to evaluate the hemostatic effect of carbazochrome salicylate under controlled experimental conditions in a double blind study on dogs with bleeding induced by tooth extractions.

■ *Method*

In this study the shed blood volumes after the extraction of two maxillary bicuspids were measured by a modification of the Evans Blue method described by Gregersen[16] and bleeding times after surgery were recorded. Twenty healthy dogs were used; ten receiving a 1 cc. intramuscular injection of carbazochrome salicylate and ten receiving similar injections of an inert placebo. It will be noted that the data from four dogs (nos. 2, 3, 4 and 5) are not included in the table. The values for these dogs were determined by a different method using Radio-Iodinated

Table • Data and calculated volumes

Table • Data and calculated volumes

Shed blood volumes

Placebo treated dogs						Adrenosem treated dogs					
Preinjection (Control)			Postinjection			Preinjection (Control)			Postinjection		
DOG	Blood rinsings (cc.'s)	Calculated shed blood volumes (cc.'s)	Blood rinsings (cc.'s)	Calculated shed blood volumes (cc.'s)	Differences associated with placebo treatment	DOG	Blood rinsings (cc.'s)	Calculated shed blood volumes (cc.'s)	Blood rinsings (cc.'s)	Calculated shed blood volumes (cc.'s)	Differences associated with Adrenosem treatment
1	100	3.6	100	3.7	+0.1	6	20	4.3	20	3.5	−0.8
8	80	7.3	80	3.2	−4.1	7	30	9.8	30	4.8	−5.0
9	60	4.2	60	7.3	+3.1	10	65	12.8	65	6.8	−6.6
11	95	14.1	95	9.6	−4.5	13	75	10.8	75	4.2	−6.6
12	50	5.3	50	4.3	−1.0	15	75	6.1	75	8.4	+2.3
14	75	4.7	75	5.5	+0.8	16	75	10.4	75	10.9	+0.5
17	75	4.6	75	20.3	+15.7	18	75	9.9	75	9.9	0
19	80	10.4	80	8.8	−1.6	20	75	9.2	75	8.0	−1.2
22	75	9.0	75	3.6	−5.4	21	75	15.2	75	10.6	−4.6
24	75	10.8	75	4.3	−6.5	23	75	5.9	75	10.2	+4.3
Av.		7.4		7.06	−0.34	Av.		9.4		7.7	−1.4

Bleeding times

Placebo treated dogs										Adrenosem treated dogs									
	Preinjection (control)			Postinjection			Difference in control and postinjection				Preinjection (control)			Postinjection			Difference in control and postinjection		
DOG	Extraction time	Subsequent bleeding	Total time	Extraction time	Subsequent bleeding	Total time	Extraction time	Subsequent bleeding	Total time	DOG	Extraction time	Subsequent bleeding	Total time	Extraction time	Subsequent bleeding	Total time	Extraction time	Subsequent bleeding	Total time
1	8	4	12	5	2	7	−3	−5	−2	6	4	2	6	8	1	9	+4	+3	−1
8	4	4	8	7	1	8	+3	0	−3	7	9	1	10	7	1	8	−2	−2	0
9	3	1	4	5	1	6	+2	+2	0	10	8	2	10	5	5	10	−3	0	+3
11	2	8	10	2	9	11	0	+1	+1	13	7	1	8	2	5	7	−5	−1	+4
12	5	3	8	2	3	5	−3	−3	0	15	4	6	10	5	4	9	+1	−1	−2
14	2	3	5	2	2	4	0	−1	−1	16	2	3	5	6	2	8	+4	+3	−1
17	8	1	9	5	1	6	−3	−3	0	18	7	1	8	4	2	6	−3	−2	+1
19	2	5	7	4	3	7	+2	0	−2	20	8	3	11	10	1	11	+2	0	−2
22	2	3	5	2	2	4	0	−1	−1	21	11	2	13	10	1	11	−1	−2	−1
24	4	1	5	2	3	5	−2	0	+2	23	10	1	11	5	1	6	−5	−5	0
Av.	4.0	3.3	7.3	3.6	2.7	6.3				Av.	7.0	2.2	9.2	6.2	2.3	8.5			
					Total difference		−4	−10	−6						Total difference		−8	−7	+1

Serum Albumin (RISA, Abbott) and may not properly be included, although the results were similar. Both bleeding time and shed blood volumes were determined prior to the administration of the carbazochrome salicylate or placebo and used as a basis for comparison with those which followed its use or use of a placebo. In each of the dogs every effort was made to remove the teeth in a manner similar to that employed when removing human teeth.

PROCEDURE—Details of the procedure were as follows:

Each dog was sedated prior to anesthesia with 10 mg. morphine sulfate injected intramuscularly. Ten minutes later the dogs were anesthetized using 30 mg. per kilogram of pentobarbital injected intravenously.

An 8 cc. sample of blood was taken from the femoral vein to serve as a control for subsequent evaluations of the Evans Blue coloration. Thirty cubic centimeters of Evans Blue solution (.1 per cent) were injected into a femoral vein.

After a 20 minute wait, an 8 cc. sample of blood was taken from the opposite femoral vein. The maxillary right first and second bicuspids were then extracted, care being taken to collect all the shed blood by using a small aspirator tip, rubber tube and collecting jar. The bleeding time was measured to the nearest minute; the rubber tubing was cleaned and the rinsing combined with the shed blood.

The dog was then injected with 1 cc. of carbazochrome salicylate or placebo[17] intramuscularly in the right flank. Both preparations being colored the same, this investigator was not aware of which agent he was injecting until the study was completed.

After a 30 minute wait to allow for the maximal development of hemostatic effect, the procedure was repeated to determine the amount of shed blood and the bleeding time after extraction of the left bicuspids. The dog was then sacrificed.

BLOOD VOLUME DETERMINATION—The shed blood volumes for each side of the dog's mouth were diluted with normal saline solution to a known volume, usually 75 cc. The blood samples were then centrifuged for 30 minutes. A Klett-Summerson Photelectric Colorimeter was used to measure the optical densities of the supernates of all samples.

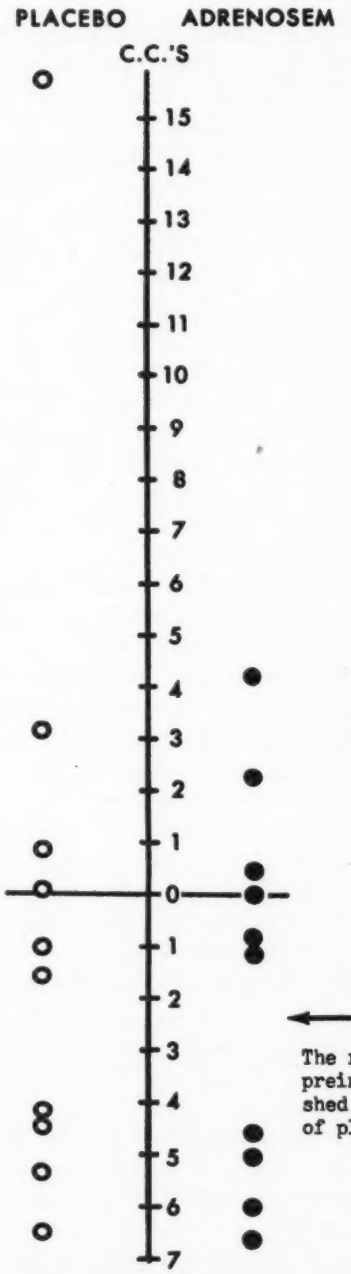
The amount of blood loss was then calculated in cubic centimeters for each side using a graph prepared at the beginning of the study. Known dilutions of Evans Blue dye were utilized. Additional checks were made on four of these dogs to establish the difference in Klett-Summerson readings associated with concentrations of Evans Blue and increased hemorrhage.

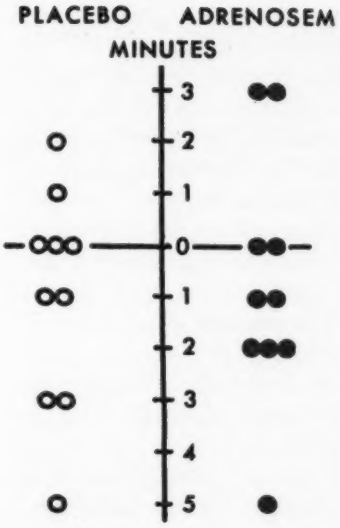
■ *Results*

Shed blood volumes and bleeding times for the placebo-injected and the carbazochrome salicylate-injected dogs are condensed in the table. The range of difference between preinjection and postinjection of a placebo or carbazochrome salicylate are also presented in the illustration.

■ *Discussion*

When a comparison is made between the shed blood volumes and the bleeding





The range of differences between preinjection and postinjection total bleeding times after injection of placebo or Adrenosem

The range of differences between preinjection and postinjection shed blood volumes after injection of placebo or Adrenosem

Range of differences between preinjection and postinjection bleeding and shed blood times after injection of a placebo or carbazochrome salicylate

times obtained with a placebo and with carbazochrome salicylate (see illustration) it will be seen that almost identical ranges are present in the two groups and that average values likewise are very close.

In the table and the illustration it will also be seen that in six of the ten dogs injected with placebo there was a reduced amount of bleeding ranging from 1 to 6.5 cc. Of the remaining, one had virtually the same amount of blood loss and three had an increased amount of .8, 3.1 and 15.7 cc. (This excessive blood loss [15.7 cc.] over its control value was due possibly to a maxillary sinus perforation. If the shed blood values obtained in this dog are omitted in our comparison, the average for placebo-injected animals falls lower than the carbazochrome salicylate values.) Six of the ten dogs injected with carbazochrome salicylate also showed a reduction in shed blood volume over the control values ranging from .8 to 6.6 cc. Of the remaining four, one was the same as the control side and three showed an increased amount of hemorrhage of .5, 2.3 and 4.3 cc. It was concluded from this that there is no serious difference in shed blood volumes after injection of a placebo or carbazochrome salicylate.

In comparing the total bleeding times it will be noted that five of the ten dogs showed shorter bleeding times after the injection of the placebo, three showed no significant difference and two showed somewhat longer bleeding times of one and two minutes; although six of the animals showed shorter bleeding times after carbazochrome salicylate, two remained identical and two gave somewhat longer values of three minutes. Again we would conclude there is no significant difference in the total bleeding times in the dogs receiving carbazochrome salicylate over those receiving a placebo under these experimental conditions.

There is a natural question as to whether bleeding time in a study of this type should be measured from the beginning or ending of a surgical procedure. If the time required for surgery is the same for each animal, either could be used with equal precision. However, where the surgical procedure may take appreciably longer on some dogs than others, it is felt that a more accurate measurement of bleeding time would be made if measured from the beginning. The bleeding times after the extractions are also presented in the table.

The results of this experimental study on dogs in which each dog acted as his own control revealed that carbazochrome salicylate would appear to be no more effective in reducing hemorrhage and shortening the bleeding time after tooth extractions than the inert placebo (colored normal saline solution). Gregersen[18] has pointed out that the correct estimation of plasma dye concentration is made difficult by the inherent color of plasma, the presence of hemoglobin which masks the Evans Blue, lipemia and the presence of residual dye. Such errors, if present, are inherent in both the placebo and the carbazochrome salicylate-injected dogs in this study and may be presumed to cancel out.

It is interesting to note the similarity of results in this experiment and Perkins' clinical study[13] in which bilateral and identical surgical procedures were used, with the first operation acting as a control for the second and carbazochrome

salicylate alone was the study drug. It seems reasonable to assume that the first operation may have set the stage for the second in which a study drug was used, and that a placebo might have resulted in a decreased blood loss as it did in this study.

It is known that clinical studies and observations can be deceiving and that many factors influence the results. The personality of the patient, the personality of the investigator and the patient's faith in his doctor adds to the efficacy of any therapeutic measure and makes the placebo an important adjunct to any clinical study.[19]

Demonstration of hemostatic effect or lack of hemostatic effect in experimental animals is not to be taken as necessarily parallel to human response. Such an experiment serves its purpose primarily by permitting control studies which cannot be done on human subjects.

A study of the problem of hemostasis reveals that there is much to be understood. As yet the role of carbazochrome salicylate in helping to reduce hemorrhage has not been defined to the satisfaction of everyone. There is a need for more experimental and clinical studies comparing carbazochrome salicylate with other hemostatic agents and placebo to confirm the earlier reports.

■ *Summary and Conclusions*

1. A review of the literature suggests that the current clinical use of carbazochrome salicylate (Adrenosem) is based on inadequately controlled studies, and therefore there is uncertainty as to its activity and its mechanism of action.

2. A double blind study on dogs under controlled experimental conditions with bleeding induced by tooth extractions before and after placebo and carbazochrome salicylate injections was carried out.

3. The results of this preliminary study show no appreciable difference in the shed blood volumes or the bleeding times in the two groups.—*1029 Medical Arts Building.*

*Thesis submitted to the postgraduate school of the University of Texas Dental Branch in partial fulfillment of requirements.

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Infections of dental etiology in the mandibular and maxillofacial region

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The diagnosis and treatment of infections of dental origin are a constant source of concern to the oral surgeon. A thorough knowledge of the fascial spaces of the head and neck where these infections may localize is essential to the proper management. The operator should have a practical plan or outline of treatment utilizing chemotherapy, adequate local treatment and supportive therapy. Bacterial culture and sensitivity tests are important since standard broad-spectrum antibiotic therapy may "mask" the symptoms of the infection.

Swellings in or about the face have always proved difficult from the standpoint of proper diagnosis and treatment. The development of the antibiotic era has not been particularly helpful from the diagnostic standpoint. Many facial infections receive a standard broad-spectrum antibiotic treatment, without regard for diagnosis or etiology. Throughout the world, in spite of great strides in the development of antibiotics—and to some extent because of this—there still remains an important problem of proper diagnosis and treatment of infection in and about the face.[1]

One of the first requirements is the complete understanding of the anatomical structures involved, and no one should be more familiar with the anatomy of the face and, more specifically, the mouth and related structures, than the dentist. There is by no means a single, simple explanation of the anatomical considerations of infections throughout the head and neck.

The potential areas where infection may localize are determined by the fascial spaces. Fascial spaces are potential areas between planes of fascia.[2] When the loose connective tissue which normally binds fascial planes together is destroyed by invading infection, the intervals thus established between the planes are referred to as fascial spaces.[3]

It is not the intention of this paper to proceed with a detailed description of the anatomic spaces involved in head and neck infections, but it is hoped that the reader will review these anatomic boundaries for a more complete appraisal of the problem. The fascial spaces will be mentioned and their location identified by drawings.

The space of the body of the mandible is a space created by the fusion of

muscular fascial layers with the mucoperiosteum of the alveolus of the mandible. Infections tend to remain localized in this space; however, as Bell[2] has indicated, they may permeate other areas. First, they may enter the oral cavity through the free mucous membrane overlying the alveolar portion of the bone on either the buccal or the lingual side. They may travel to the outside of the face by penetrating the periosteal covering of the mandible (Fig. 1). A third possibility is that the infection may pass posteriorly to the masticator space. Infections may also spread to the floor of the mouth if the apexes of the teeth involved lie above the mylohyoid muscle attachment, as is usually the case with incisors, cuspids and bicuspids, or into the submaxillary space if the teeth are below the mylohyoid muscle, as may occur with bicuspids and molars (Fig. 2).

The limits of the space of the body of the mandible are generally accepted to be from the symphysis of the mandible to and including the third molar. Infections in this region often are drained adequately by incisions within the mouth on the buccal aspect of the mandible in the depth of the mucobuccal fold (Fig. 3). Extraoral incision and drainage can be resorted to when necessary by making an incision through the skin and subcutaneous tissue and periosteum, beneath and parallel to the inferior border of the mandible (Fig. 4).

The masticator space is determined by the continuation of the same fascial layers as the space of the body of the mandible. This space is frequently subdivided into the superficial and deep temporal spaces. Its contents are essentially the ramus of the mandible and the muscles of mastication, that is, the masseter muscle, pterygoid muscles and the temporal muscles.

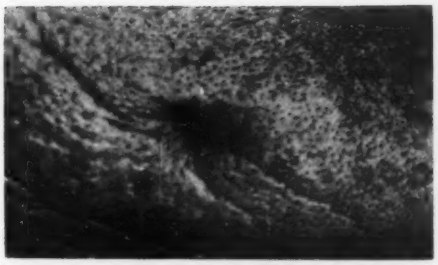

Fig. 1—Draining sinus tract from first molar

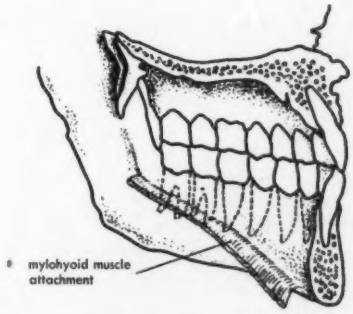

Fig. 2—Lingual view showing relationship of apexes of teeth to mylohyoid muscle attachment

Fig. 3—Intraoral incision and drainage of space of body of mandible (rubber drain sutured in place)

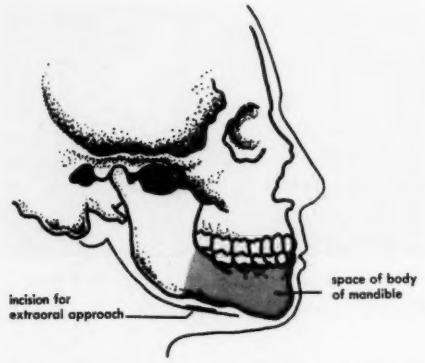

Fig. 4—Space of body of mandible and extraoral incision and drainage

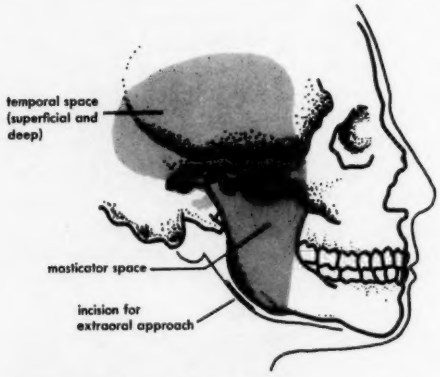

Fig. 5—Masticator and temporal spaces and area for extraoral drainage

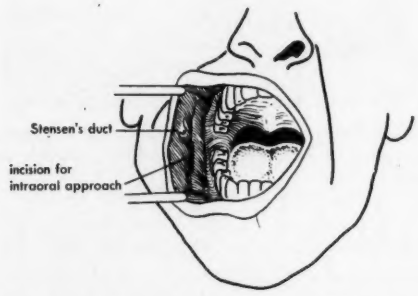

Fig. 6—Intraoral view showing point for incision and drainage of masticator space

Infections of this space usually occur through extension from the space of the body of the mandible, parotid space or lateral pharyngeal space, suppurative middle ear disease, septic material on the needle in mandibular injections and from osteomyelitis of the zygomatic or temporal bones.[4] Postoperative infection after surgery involving the ascending border of the ramus, as in operations for the removal of lower third molars, also could involve the space.

Intraoral drainage of this space can be accomplished by an incision parallel with the anterior border of the masseter muscle; however, special concern has to be given to the location of Stensen's duct. Extraorally, an incision can be made below and behind the angle of the mandible, allowing good exploration of the medial and lateral aspects of the mandible (Fig. 5 and 6).

The usual symptoms of infection are evident: pain, swelling, increase in temperature and pulse, and so forth. Additionally, trismus is frequently noted when this space is involved.

The lateral pharyngeal space is a visceral vascular space rather than a muscular fascial space,[1] the main difference being that here the fascia covers viscera instead of muscle and allows for more rapid dissemination of the infection. This space lies medial to the ramus and actually includes the pharyngeal tissues. It has also been referred to as the pharyngomaxillary space. The boundaries of this space are such that infections may extend to the base of the skull superiorly and into the chest inferiorly.

Extension of infection into this space may occur from the tonsils, floor of mouth,

space of the body of the mandible, and the masticator space.

Symptoms for involvement of this space are the same as for all others in regard to the systemic reaction to infection with the addition of some local factors. Here fluctuation is not easily detected since palpation is difficult. Dysphagia is a constant symptom, and the patient talks with a characteristic garbled and indistinct sound in advanced stages of the infection.

Incision and drainage is best accomplished intraorally through the lateral pharyngeal wall with the patient under a general anesthetic (Fig. 7).

Infections involving the anterior triangle of the face are those occurring at the base of the lip, and from the canine fossa (Fig. 8). These can be serious infections because of the venous drainage of this region. The infection in such instances disseminates from the superior labial venous plexus into the facial vein, and may find entrance into the cranium through the angular vein to the superior ophthalmic vein and into the cavernous sinus.[5]

The usual etiological factor here is infection from the apexes of the anterior teeth. Incision and drainage of infections involving the base of the upper lip or the canine fossa are best accomplished intraorally in the depth of the mucobuccal fold of the region involved.

The parotid space has been mentioned but not described, since relatively few infections of dental etiology reach this space.

After a thorough understanding of the anatomy of the tissues involved, the clinician will be able to treat his patient with confidence and observe more capably the progress of the infectious process.

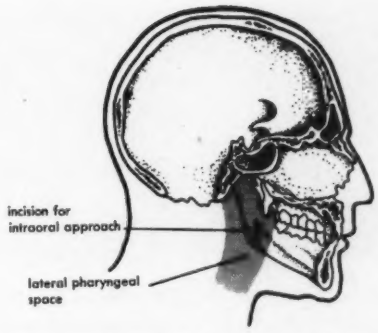

Fig. 7—Intraoral view of lateral pharyngeal space and area for drainage

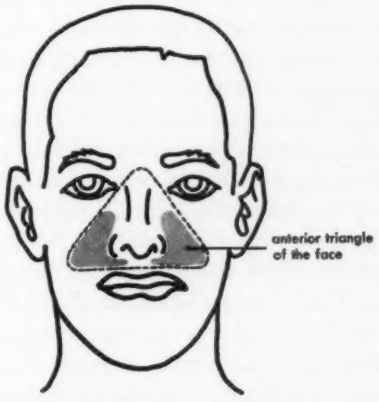

Fig. 8—Anterior triangle of face

■ *Treatment of Acute Infections*

For the successful treatment of acute oral infections, the following outline[6] can be used as a guide:

1. The bacteria are combated with chemotherapy.
2. The tissues are treated by:
   a. Incision and drainage.

b. Removal of diseased teeth and necrotic bone.

3. Supportive therapy.

a. Rest.

b. Fluids.

c. Nourishment.

d. Analgesics.

e. Physical therapy.

A complete discussion of the bacteria involved in oral infection and the proper choice of antibiotic would require an extensive study; however, it should be noted that proper identification of the bacteria prior to selection of the antibiotic is desirable. This is not always possible since time is a factor in treatment and at least 48 hours is necessary for this process. It is a simple matter to obtain the material for a culture by using a sterile swab to contact a small amount of the pus or exudate and submitting it to the bacteriologist. A request should be made for (1) identification of the organism, and (2) the antibiotics to which it is sensitive. There are several other points which are helpful in clinically making this evaluation, such as a knowledge that the great majority of oral infections are caused by the staphylococcus and streptococcus organisms. The nature of the exudate and the apparent ability of the infection to spread is also helpful to the clinician in making a diagnosis. The patient's systemic reaction is frequently an indication as to the virulence of the organism.

A decision as to the proper choice of antibiotic has now become a grave and somewhat complicated procedure partially because of past indiscriminate use of antibiotics. Some patients now are sensitive to many of the present antibiotics; such sensitivity has caused serious illness, even death. Another complication is the resistance of microorganisms to various antibiotics; such resistance can be determined only by the bacteriologist. Patient sensitivity can best be minimized by the taking of a good history. As a rule of thumb, it is the author's opinion that antibiotics should not be resorted to for every little flare-up, but the patient should be given an opportunity to build his own resistance and reserve the antibiotics for more serious infections.

Treatment of the tissues most certainly must not be overlooked. It is not uncommon to see the patient who has been treated with antibiotics for several days, with no local treatment, ultimately having no improvement. In this instance, the antibiotic has only served to "mask" the infection and allow the microorganisms to become more resistant. In such instances incision and drainage are important adjuncts to treatment. This form of therapy can only be carried out with a proper understanding of the anatomy involved. Dependent drainage and the use of rubber drains to keep the tissues open for drainage are procedures often neglected (Fig. 9). When incising for drainage, it is important to know when the time is "right," which is best determined if the infection is fluctuant. The incision should be made to bone and through the periosteum. A blunt instrument or hemostat should be inserted and the tissues spread to create accurate drainage. It should be remembered, however, that minimal tissue manipulation is a cardinal principle in acute infection.

The removal of diseased teeth and necrotic bone is an important factor for concern, and fortunately is usually recog-

nized as such by the dentist. There is, however, a difference of opinion as to the proper time for removal of the involved tooth during an acute infection. There are those who believe that a tooth is never too "hot" to extract. However, extraction in such instances is an insult to the involved tissues and may open new routes for the infection to spread, especially to the medullary portion of bone. A proper sequence of treatment would be to provide adequate drainage of the infected tissue and remove the tooth when the infection is controlled.

The resistance of the patient cannot be overlooked, and its importance increases with the severity and duration of the infection. Adequate rest is frequently disregarded as an important requisite in the supportive therapy of infection. It is unfortunate that the patient's attitude is frequently one of unconcern when he has a swollen face as a result of "only an ulcerated tooth," whereas he may be quite alarmed about a headache or sore throat. Increased fluid intake is important from the standpoint of proper hydration and the control of body temperature. The dilution factor and the turnover of body fluids are also important considerations.

The diet during infection should not be neglected, as it definitely has an influence on the incidence, course, and final outcome of the infectious process.[7] Depending on the location of the infection and the ability of the patient to masticate, a liquid or soft diet may be indicated. Analgesics may be necessary for the control of pain and temperature. By careful selection of these drugs, a patient may remain comfortable and ambulatory during the surgical and postoperative period.

Fig. 9—Incision and drainage at base of upper lip for involvement of anterior triangle of face (rubber dam drain not shown)

Physical therapy is important in the various facets of infection control. The toxic substances produced by infectious processes will frequently cause facial muscles to go into spasm and cause trismus. By careful exercising of these muscles or massage, this can be avoided. However, any mechanical pressures to involved tissues prior to incision and drainage can contribute to the direct spread of the infection. Hydrotherapy is a valuable aid in the localizing of infection and is contributory during the postinfection healing period. The proper use of heat and cold seems to be constantly misinterpreted. In general, it can be said that cold is only used in the minimizing of immediate postsurgical trauma and heat is used in the treatment of infection. Heat properly used intraorally or extraorally will substantially speed up the localizing of infection. Moist heat seems to be better than dry heat. Conversely, cold will retard the infectious process. After surgical intervention, heat can also be used effectively. The capillaries are dilated, creating a constant change between the removal of the accumulating toxic materials and the nutrient supply to the tissues. Basi-

cally, heat increases the metabolic process of the part involved, as does the increase of the patient's temperature.

A frequent complication in the treatment of oral infections is that of satisfactory anesthesia. If local anesthesia can be obtained without injecting into inflamed tissues, it is usually satisfactory to proceed with incision and drainage. However, if this cannot be done, a general anesthetic should be considered.

■ *Summary*

The diagnosis and treatment of dental infections has been discussed. A complete understanding of the anatomy of the tissues concerned is a prerequisite to the treatment of oral infection. Special emphasis should be placed on identification of the causative organism and its antibiotic sensitivity. The general care and supportive therapy of the patient are of prime concern to the dentist and become paramount when treating an infectious process.

*Department of oral surgery, State University of Iowa College of Dentistry.

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■ Sports and Sport Injuries

To many people sports mean competitive sport and the development of outstanding athletes. . . . Let us not forget, however, that the large number of sport participants fail to reach top standards. Their efforts are not wasted and their work is just as important. The greatest value of sport is in raising the general standard of physical and mental health in the community. . . . It becomes important to pay attention to the prevention and treatment of sport injuries. Some sports have hazards peculiar to themselves, brain damage in boxers, jaw and tooth impairments in footballers, head injuries in cyclists and fractured legs in skiers. The treatment of sport injuries is peculiarly difficult because of the tendency, particularly in competitive sports, to return to activity before recovery is complete. The pressure for such premature resumption of sporting activity comes not only from the athlete himself, but even from clubs and schools, and must be resisted by physicians and dentists at all costs. Such premature resumption of sport activity before recovery is complete only leads to further complications and prolonged disability, both of which are harmful, not only to the athlete but to clubs and schools. It should be realized that it never pays to have unfit men participate in sports.—*L. T. Wedlick, Sports Injuries, The Medical Journal of Australia, June 13, 1959.*

Effect of antihistaminic agents on inflammatory response after surgical trauma

■ *Bernard S. Snyder, D.D.S., M.Sc., Columbus, Ohio*

Forty patients with bilaterally similar unerupted or partially erupted mandibular third molars were employed in a well designed clinical study to evaluate the ability of antihistamines to reduce postoperative swelling and pain. Each patient served as his own control, receiving an antihistamine for the removal of one tooth and a placebo for the removal of the other. The results showed no significant improvement in the postoperative course from the use of antihistamines, and further suggested that histamine may not always be the primary factor producing the inflammatory response after trauma.

Antihistamines have been suggested to reduce postoperative swelling and pain, and improve wound healing after oral surgery.[1-3] Most of the claims have been based on clinical observations without the use of adequate controls. Accurate controls were used in this investigation which clinically evaluates antihistamines as anti-inflammatory drugs and relates the reaction after surgery to a known histamine response.

■ *Methods*

Forty patients with bilaterally similar unerupted or partially erupted mandibular third molars were selected. These patients varied in age from 19 to 38 years and were in good general health.

The 40 patients were divided into four groups of ten patients each. A control and experimental side of the mouth was designated arbitrarily for each patient. For the experimental side, preoperative and postoperative systemic antihistamines were used in conjunction with the surgery. Placebos were administered in a similar manner for the control side. All patients and all groups were managed in exactly the same manner except for the antihistamine used, the method of its administration and dosage. Table 1 shows the variation in the antihistaminic medication for each group.

The mandibular third molars were removed at two separate appointments for each patient. All surgery was performed by the author. Typical examples of the teeth removed are shown in Figure 1. Since both of these teeth were at an angle and mesially inclined and were in about the same position, nearly equal operative time and trauma were necessary for their removal. The surgery time for all extractions was tabulated. All surgery was performed under the same type, and

Table 1 • Variations in antihistamine medication according to groups

Group 1—Promethazine hydrochloride (Phenergan*)
12.5 mg.—Orally the night before surgery
6 mg.—Twice a day orally for three days
Group 2—Tripelennamine hydrochloride (Pyribenzamine†)
25 mg.—Intramuscular; 30 minutes prior to surgery
50 mg.—Every four hours orally for three days
Group 3—Chlorprophenpyridamine maleate (Chlor-trimeton‡)
40 mg.—Intramuscular; 30 minutes prior to surgery
12 mg.—Three times a day; repeat action tablets orally for three days
Group 4—Promethazine hydrochloride (Phenergan*)
25 mg.—Intramuscular; 30 minutes prior to surgery
25 mg.—Twice a day orally for three days.

*Phenergan supplied for this study by Wyeth Laboratories, Philadelphia.

†Pyribenzamine, Ciba Pharmaceutical Products, Inc., Summit, N.J.

‡Chlor-trimeton, Schering Corporation, Bloomfield, N.J.

as nearly as possible, the same volume, of local anesthesia. The experimental sides were divided equally between right and left since some surgeons operate better and easier on one side than the other. No antibiotics or other medication were used except the antihistamines, placebos, and necessary analgesics.

In order to establish a relationship between postoperative sequelae and histamine reaction, each of the 40 patients was skin-tested just prior to surgery with a 1:1,000 solution of histamine phosphate. A pin prick was made on the volar surface of the forearm through a drop of this solution. A control skin test using a saline solution was done on the opposite arm. One skin test was made with no antihistamines present in the body and a second test was performed after the patient had received antihistamine medication. The diameters of the wheal and flare after all skin tests were measured, recorded and photographed. All information concerning each patient was placed on an individually prepared standard form (Fig. 2).

The patients were seen at 24, 48, and 96 hours postoperatively. The observations on amount of edema, trismus, bleeding, temperature and white blood cell count, and analgesics and healing were recorded as follows:

Total edema and cheek edema were measured with calipers. Total edema was measured from a point on the skin to a point on the lingual alveolar ridge just distal to the cervical aspect of the second

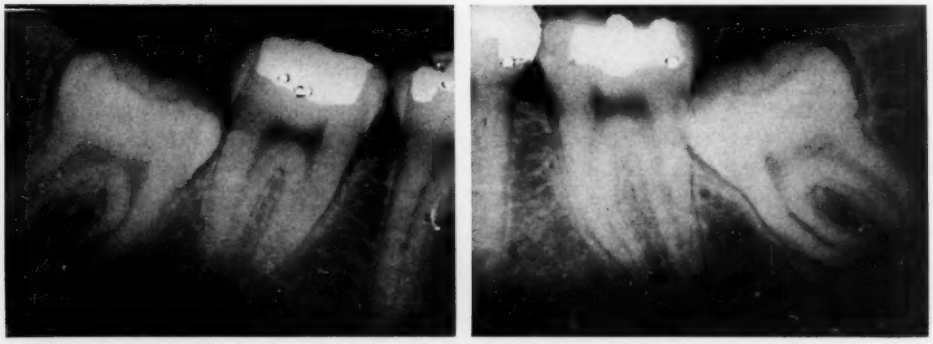

Fig. 1—Left: View of experimental side of patient 28. Right: Control side, same patient

Experimental side..... Antihistamine used..... Age of patient..... Sex of patient.....

Experimental data	Experimental	Control
1. Histamine test (size of wheal & flare in mm.)		
2. Surgery time (minutes)		
3. Cheek edema (millimeters)		
4. Total edema (millimeters)		
5. Edema index (millimeters)		
6. Trismus (millimeters)		
7. White blood cell count (preoperative and postoperative)		
8. Temperature (preoperative and postoperative)		
9. Number analgesic tablets (4 day period)		
10. Number narcotic tablets (4 day period)		
11. Delayed healing—cases		
12. Bleeding index (subjective)		
13. Easier side (subjective)		

Fig. 2—Standard form completed for each patient in study

molar. Cheek edema was measured through the thickness of the cheek alone at the same point. An edema index was determined by using one half of the sum of the total edema and cheek edema.

Trismus was calculated by subtracting the measurement of the jaw opening after surgery from the amount of opening before surgery. This measurement was taken as the distance from the incisal edges of the mandibular anterior teeth to the incisal edges of the maxillary anterior teeth.

The patient was asked if, in his opinion, he had minimal, moderate, or severe postoperative bleeding. These subjective opinions were graded and recorded as minimal (1), moderate (2), and severe (3).

Sublingual temperatures and white blood cell counts were taken preoperatively and at 24, 48, and 96 hours postoperatively.

The number of PAC or narcotic tablets taken in the four day postoperative period was tabulated. Observations were made of normal or delayed healing of the extraction sites at the 96 hour check.

■ *Results*

Patients were classified according to histamine response and averages of results were grouped (Table 2). After the histamine skin test, a characteristic wheal and flare were observed in every patient in somewhat varying degrees. After antihistamine premedication, this inflammatory response was considerably decreased in every patient. The response to the control skin test using saline was negligible (Fig. 3).

The average time of surgery was nearly equal on both experimental and control sides for all 40 patients (80 impacted teeth). The amount of edema, trismus and bleeding was also similar for all patients (Fig. 4). The white blood cell count and sublingual temperatures were

within normal limits both preoperatively and postoperatively. There was no significant difference in the use of analgesics.

The 20 patients with the lesser reaction to the histamine skin test were grouped separately and the same responses calculated as were recorded for the total group of 40 patients (Group 2, Table 2). Patients with the lesser reaction to the histamine skin test had over-all responses slightly lower than average for all patients.

The same reactions for the group of 20 patients with the greater reaction to the histamine skin test were recorded (Group 3, Table 2). These patients with the greater reaction to the histamine skin test had responses which were slightly higher than the average for all patients.

Surgery time was slightly more than average for the group with the greater reaction to the histamine and slightly less than average for the group with the lesser reaction to histamine (Table 2). The intensity of the inflammatory response after surgery may depend primarily on the surgery time and the amount of trauma involved.

The response to the histamine skin test was reduced by at least one half after administration of antihistamines to 23 of the patients. Responses of these patients were grouped for evaluation of their inflammatory reaction to surgical trauma (Group 4, Table 2). If histamine is the primary factor concerned in the inflammatory response after trauma, and antihistamines greatly reduce the response of an individual to a skin test of histamine, they should likewise noticeably reduce the inflammatory response of that individual after surgical trauma. This group then, more than any other, should show great deviation from the average and considerable difference between the control and experimental sides. However, this

Table 2 • Relation of antihistamines to inflammatory response after surgery (Averaged figures compiled for total patients in each group)

Group	Surgery time (min.)		Edema index (mm.)		Trismus (mm.)		Pain Analgesics in 4 day postoperative period		Delayed healing (cases)		Bleeding index 1.0–Minimal 2.0–Moderate 3.0–Severe	
	Exper.	Control	Exper.	Control	Exper.	Control	Exper.	Control	Exper.	Control	Exper.	Control
1. All patients (40) Number of teeth (80)	16.13	16.53	4.96	4.28	12.10	11.80	10.78	12.35	8	7	1.03	1.15
2. Patients with lesser reaction to histamine skin test (20)	13.15	16.20	4.65	3.93	9.90	8.90	8.65	11.00	4	3	0.95	1.10
3. Patients with greater reaction to histamine skin test (20)	18.60	18.15	5.40	4.68	14.35	13.75	12.95	14.00	4	4	1.10	1.20
4. Patients in whom skin test was reduced at least one half by antihistamine premedication (23)	15.00	15.35	5.24	4.39	13.83	12.35	9.57	10.44	4	5	1.22	1.35

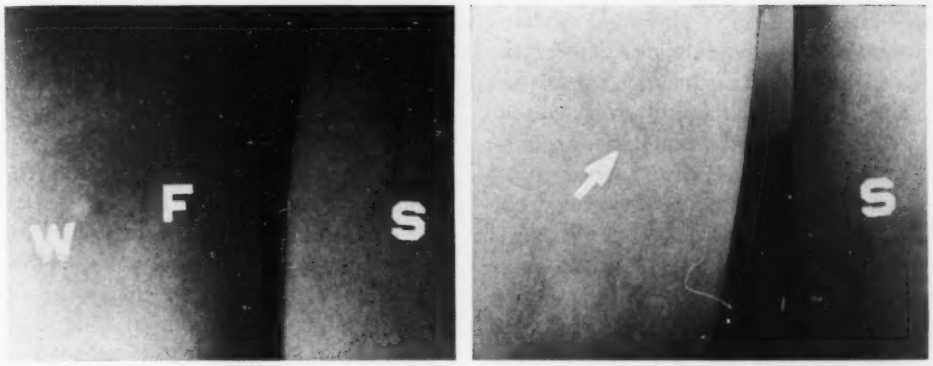

Fig. 3—Left: Histamine skin test without premedication: wheal, W; flare, F; area of saline injection, S. Right: Same test after antihistamine premedication: histamine wheal indicated by arrow; area of saline injection, S

was not found to be true. Results for experimental and control sides for these patients were very similar and varied only slightly from the averages for the complete group. There were no statistically significant responses. (All data and calculations obtained from this investigation were subjected to statistical analysis by the statistical laboratory, department of mathematics, Ohio State University.)

■ *Discussion*

Histamine is a natural constituent of almost all body tissues.[4] Many investigators[5] believe that histamine or a histamine-like substance may be released by

Fig. 4—Left: Patient 28. Center: Control side, same patient, postoperative view. Right: Experimental side, same patient, postoperative view

the tissue cells after chemical, mechanical or thermal stimulation. One of the most important reactions to histamine is vasodilation. An unusually high concentration of released histamine will cause the capillaries to dilate to such a degree that their permeability is increased. Increased permeability permits escape of plasma protein and fluid into the tissue spaces with subsequent edema.

The cutaneous blood vessels and blood vessels of the oral mucous membrane are exposed to external stimuli. They bring those substances necessary for nutrition and growth to the skin or mucous membrane and carry away products of their metabolism. These vessels also form an essential part of the mechanism of defense against injury. Intradermal histamine produces a local dilation of capillaries causing a dark red or purple spot around the site of the injection. Next, reflex dilation of surrounding arterioles gives rise to an irregular red area 3 to 5 cm. in diameter, the flare. Leakage of fluid from the dilated capillaries produces an area of localized edema 4 to 5 mm. in diameter, the wheal. The end result is a pale center with a surrounding red flare which looks like a mosquito bite. This reaction of a tissue to irritation is termed the "triple response."[6]

A histamine-like substance may be absorbed into the blood stream when tissues are severely damaged, and the effects observed may be similar to those experimentally produced by histamine. One thing is certain; the substance that sets off the defense reaction is a chemical agent derived from the tissues. The defense mechanism is organized immediately and carried out locally, independent of the higher centers of nervous control or cardiovascular distribution. It is this concept of the physiology of inflammation that prompted the theory that antihistaminic agents might counteract the usually unpleasant symptoms accompanying the inflammatory response.

Many physiologists modify this basic philosophy of inflammation with their own theories.[7] Others[8] present an almost entirely different concept.

For antihistamines to be effective in combating inflammation, histamine must be considered to be the primary cause of that inflammation, or a highly important factor in it, or antihistamines must have other mechanisms of action. It is very likely that many substances play a part in producing the inflammatory response.

An antihistamine may be defined as a counterpoison having little or no specific activity of its own in a normal animal. Its properties become apparent only when it can manifest a detoxifying power against the action of histamine.[9] It prevents access of histamine to the receptor site in the cell and blocks any response of the effector cell to histamine. Antihistaminic drugs vary in potency, dosage, side effects, and type of preparations available for administration, but there is little difference in the efficiency of the various preparations. The antihistamine of choice is the drug which will give the greatest opportunity for therapeutic success with minimal chance of side action. Unfortunately, no single drug is outstanding in this respect; therefore, clinical judgment and personal opinion must determine the preparations to be used.[10] Side effects include drowsiness, dizziness, tinnitis, and blurred vision. Hyperirritability, head-

aches, nausea, and dry mouth may occur.

It would add greatly to the postoperative comfort of patients who undergo oral surgery if the cardinal signs of inflammation could be controlled without inhibition of the healing process. Many clinicians have given patients antihistamines to counteract the responses supposedly due to the release of histamine after surgical trauma. The rationale for this treatment is based on the theory that histamine or a histamine-like substance is the major factor in initiating the inflammatory response. It is important from a clinical and economic, as well as a scientific, point of view to determine if these drugs are of therapeutic or prophylactic value.

If histamine is a major factor in the inflammatory response, it was hypothesized that the inflammatory response occurring from a skin test with histamine should give an indication as to the inflammatory response of that same person to trauma. If antihistaminic premedication would reduce the inflammation resulting from a second skin test of histamine, it should reduce the inflammatory sequelae to trauma in this person when compared with sequelae from similar degrees of trauma without antihistamine medication. It was this hypothesis which prompted the research work reported in this paper.

The results obtained indicate that the antihistaminic drugs do not alter appreciably the postoperative course after surgery. The antihistamines apparently have been over-rated so far as their ability to control effectively pain, edema, trismus, healing, or bleeding after oral surgical procedures is concerned. Many other reports have been released recently which support the results of this study.[11-13]

In view of these findings, it may be that the opinions concerning the basic physiology of inflammation should be reviewed. There is a distinct possibility that histamine is not always the primary factor in producing the inflammatory response after trauma, but is only one of a multitude of interrelated substances having a more or less important influence on the inflammatory response in various individuals.

■ *Summary*

1. A clinically controlled investigation was made of the use of antihistamines to reduce inflammatory sequelae after oral surgery. The reaction after trauma was also related to a known response from a histamine skin test.

2. After surgical removal of 80 impacted teeth (40 controls, 40 experimental), with each patient serving as his own control, there was no significant improvement in the postoperative course from the use of antihistamines.

3. The results of the investigation suggest that histamine is not always the primary factor in producing the inflammatory response after trauma, but only one of several interrelated substances having a more or less important effect on the inflammatory response in various persons.—*196 East State Street.*

Condensation of a thesis submitted in partial fulfillment of the requirements for a degree of Master of Science (Oral Surgery) at Ohio State University, 1956.

*Former resident in oral surgery, Ohio State University; assistant professor in dentistry, division of oral surgery and anesthesia, College of Dentistry, Ohio State University.

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Influence of gelatin film over extraction wounds in dogs

■ *Donald L. Wilson,* D.D.S., M.Sc., Massillon, Ohio*

An absorbable gelatin film was used to stabilize the blood clot and to reduce alveolar resorption after dental extractions in an experiment carried out on dogs. Inflammatory response was minor in most instances and healing was not impaired. The possibility of its use in human beings is suggested.

An absorbable gelatin film has been made to cover surgical defects, prevent adhesions and reduce undesirable connective tissue scarring. The purpose of this study was to determine the effect of this material on surgical wounds in dogs.

The biological characteristics of this gelatin film have been studied and its surgical usefulness tested.[1-4] This study indicated that this gelatin material was well tolerated in surgical wounds.

■ *Materials and Methods*

The material used was a sterile, nonantigenic, absorbable gelatin film (Gelfilm) approximately 0.075 mm. in thickness. It has the appearance and stiffness of cellophane in the dry state. It assumes a soft, rubbery consistency and can be adapted easily to irregular surfaces when moistened.

The dog is a desirable animal for this type of study. Extraction of anterior teeth with a large operative area facilitated oral implants of the material. Subcutaneous implants were inserted into the hips of these dogs. Four male dogs were used.

An intravenous barbiturate was used for anesthesia. An incision was made around the necks of the two anterior teeth to be removed. Labial and lingual mucoperiosteal tissue was deflected and the

teeth removed. The gelatin film (¼ by ½ inch) was placed over one of the extraction sites subperiosteally. The other alveolus was used as a control. The mucoperiosteal tissue was closed over the entire surgical area. Tissue edges were held in contact by no. 000 chromic gut sutures.

These operations were performed on each animal at the following time intervals prior to sacrifice: 90 days, 60 days, 30 days, 15 days and 2 days. The hard and soft tissue specimens were taken and prepared for microscopic examination immediately after sacrificing the animals.

■ *Results*

The time sequence of the specimens provides a picture of the processes involved in the tissue reaction to the absorbable gelatin film. The film was absent in all hard tissue specimens because of the decalcification process.

TWO DAY SPECIMEN—In the soft tissue implant (Fig. 1), the gelatin film was completely surrounded by a fibrin matrix which was probably the result of clotting. Moderate edema was present in the surrounding tissues. Diffuse acute inflammation was seen. No positive resorption of the gelatin film was evident. Examination of the 48 hour bone specimens revealed an organizing clot in the alveolus (Fig. 2, left). The gelatin film space, that is, the empty space previously occupied by the gelatin film, exhibited a regular margin and an adjacent organized clot with hemorrhage and minimal inflammation (Fig. 2, right).

FIFTEEN DAY SPECIMEN—Acute inflammation was not apparent on the fifteenth day in the soft tissue specimen. A dense fibrous connective tissue matrix surrounded the gelatin film. No active resorption of the gelatin film was evident. Vacuolation of the film is artifact (Fig. 3).

On the fifteenth day a well-organized clot was present in the alveolus. Granulation tissue included bone trabeculae with osteoblasts at their margins (Fig. 4). The gelatin film space remained unaffected in all specimens (Fig. 5). The clot previously surrounding the gelatin film space had undergone organization forming a fibrous connective tissue capsule. An occasional large macrophage was present. There was minimal inflammatory reaction.

THIRTY, SIXTY AND NINETY DAY SPECIMENS—In the soft tissue specimens (Fig. 6 and 7) at these time intervals there was a progressive reduction in inflammation. No evidence of active resorption of the gelatin film existed. Few lymphocytes and plasma cells could be seen. A dense fibrous connective tissue capsule with moderate cellularity surrounded the gelatin material.

The hard tissue specimens at these intervals showed a healed socket (Fig. 8, left). The cancellous bone with marrow spaces was well established. The gelatin film space was present in all specimens and was enclosed by a well-organized fibrous connective tissue capsule (Fig. 8, right). The cellular elements were mainly spindle-shaped fibroblasts. There was no significant evidence of macrophage activity.

CONTROL SPECIMENS — All control sections showed a normal progressive heal-

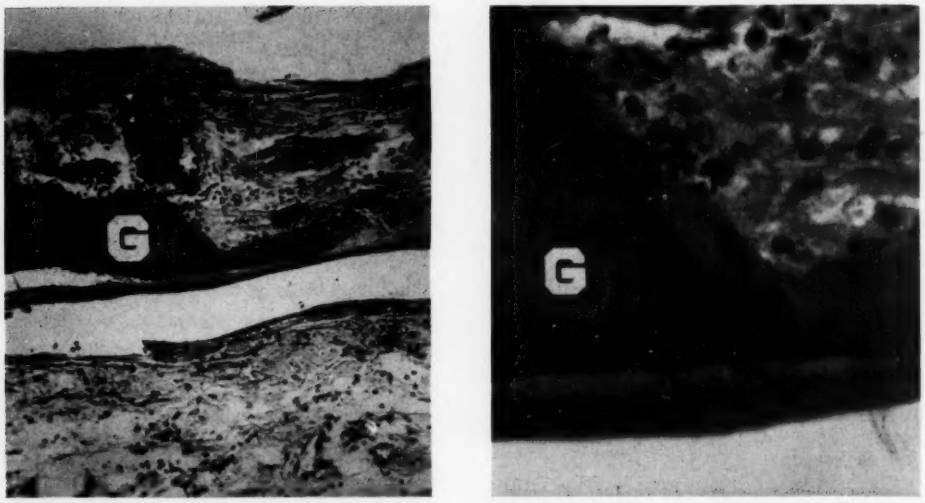

Fig. 1—Left: Forty-eight hour soft tissue specimen. Gelatin film implant (G). Right: Higher magnification of view at left. Gelatin film implant (G)

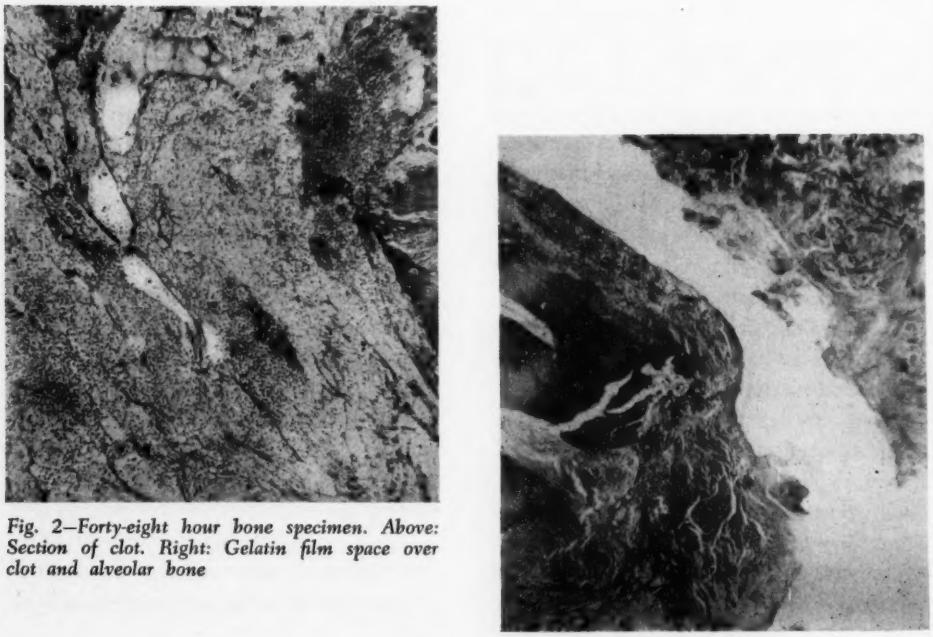

Fig. 2—Forty-eight hour bone specimen. Above: Section of clot. Right: Gelatin film space over clot and alveolar bone

Fig. 3—Fifteen day soft tissue specimen. Vacuoles are artifacts

Fig. 4—Fifteen day bone specimen. Note bone formation in alveolus

Fig. 5—Fifteen day bone specimen. Gelatin film space over alveolar bone

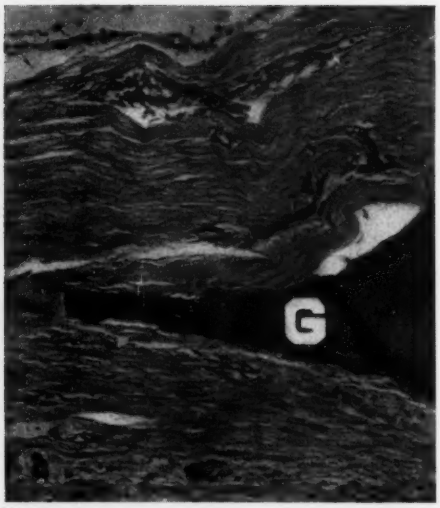

Fig. 6—Thirty day soft tissue specimen. Gelatin film implant indicated by G

Fig. 7—Ninety day soft tissue specimen. Gelatin film implant indicated by G

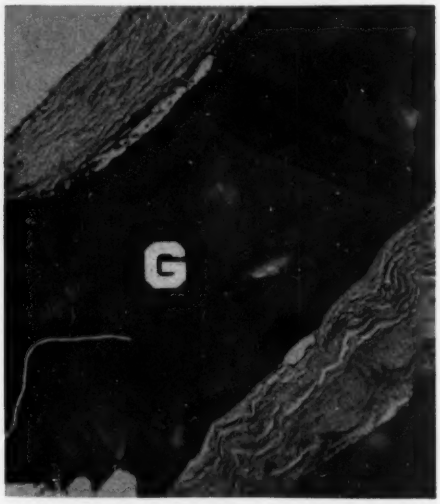

Fig. 8—Ninety day bone specimen. Left: Bone formation in alveolus. Right: Film space over alveolar bone

ing pattern at the various time intervals. This was comparable to the repair process seen in the experimental sections.

■ *Summary*

A method using absorbable gelatin film to stabilize the blood clot and to reduce alveolar bone resorption after tooth removal has been investigated. Implants of the gelatin material were placed in soft tissue and over recent extraction wounds in dogs. No effects were seen which might contraindicate the use of gelatin film implants.

The results of this study revealed minimal inflammatory reaction. An acute inflammatory response was present in all of the two day specimens comparable to that seen in the control specimens. All the remaining specimens revealed minimal inflammation with progressive healing of the sockets and soft tissue repair. The gelatin film remained for a sufficient length of time for the healing to take place.

The healing of the extraction wounds was neither enhanced nor delayed by the absorbable gelatin film. Use of the film over mandibular extraction wounds in human beings as a method of protection of the clot and preservation of alveolar bone is suggested for future investigations.—845 *Eighth Street, N.E.*

Thesis submitted in partial fulfillment of the requirements for a degree Master of Science (Oral Surgery) at Ohio State University, 1959.

*Formerly, resident in oral surgery, Ohio State University.

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■ Necessity for Animal Experimentation

As between man and animals, man comes first. This is the law of life. But when man uses or destroys animals for man's own protection, aid, and other needs, such use must be conducted without cruelty. Certainly it cannot be immoral to use animals humanely to mitigate human suffering due to disease, as long as we believe animals may be sacrificed for human food and clothing. If man is not worth more than the dog, then our effort to improve man is an error. And we had better start raising more dogs and destroying more men, women and children for the good of the dog, so that the canine species may inherit the earth.—*Anton J. Carlson.*

Combination of prednisolone and vitamin therapy in the control of postoperative edema

■ *S. David Freedman,* D.D.S., Atlantic City, N. J.*

The effect of a combination of prednisolone, citrus bioflavonoid complex, and ascorbic acid in the reduction of postoperative edema and soreness was investigated in 124 patients undergoing multiple extractions. The patients receiving the study medication had more reduction in edema, soreness, pain and ecchymosis than the control group. However, this is only a preliminary report and more work remains before any conclusions can be made.

Many antihistaminic drugs have been used in the last five years in the control of postoperative edema due to various oral surgery procedures. Results have been varied in the respective studies. Recently a paper has been published reporting the use of intramuscular trypsin for the prevention of such edema.[1]

Because the department of oral surgery at the Wheeling Hospital considered that the inflammatory response to trauma plays an important role in the cause of such edema, it was decided that a specific anti-inflammatory drug in small doses might control this reaction. The effectiveness of corticosteroid drugs as anti-inflammatory agents has been so well documented that no further discussion on this point will follow.

It has been stated that vitamin C is needed in the healing process and that bioflavonoids will aid the manufacture of the intercellular cement substance of the capillary wall,[2] thus aiding in the reduction of hemorrhage. This strengthening of the capillary wall will, in itself, cause a retardation of the inflammatory response and thus act as an anti-inflammatory agent.[3]

Hence it appeared to be possible that a combination of vitamin C and water-soluble bioflavonoid complex and a steroid drug would be effective in the control of edema and other postoperative sequelae. The drug used in this study was Predni-C.V.P. Each capsule is stated to contain prednisolone, 4 mg.; citrus bioflavonoid complex, 100 mg.; ascorbic acid, 100 mg., and suitable antacids to act as buffers.

A discussion of the effects of prednisolone and its contraindications is beyond the scope of this report. If the reader is interested in pursuing this subject he is

referred to any recent pharmacology text and to several recent journal reports.[4-6]

In the dosage used for this study 56-60 mg. of prednisolone was given over a four day period. It is considered that this is a small dose for this drug and that little or no somatic difficulty would be encountered, as at least ten days' therapy is considered necessary for adrenal repression.[7] Further, massive doses of antibiotics were not considered necessary to prevent the spread of infection, although in indicated cases anti-infection therapy was duly prescribed. It might be added that corticosteroid treatment is currently the drug of choice in treatment of allergies. Thus the drug gave the patients an added measure of safety. In the entire series of patients in this study, one patient developed angioneurotic edema after receiving penicillin therapy. As she was already on the study medication, no further treatment (aside from withdrawal of the offending agent) was given and the allergic swelling was reduced effectively.

■ *Method*

One hundred and twenty-four patients who were admitted to Wheeling Hospital took part in this study. Most of the patients underwent full mouth extractions; the average number of teeth extracted was 20.4. Alveolectomy was performed in all instances of full mouth extraction. Ninety per cent of the extractions were carried out by one man (S.D.F.).

The patients were divided into three groups. The patients were screened only to rule out any systemic diseases in which corticosteroid drugs would be contraindicated. Any such patients who did fall into this category were placed automatically into the control group. All patients in the study were told they would receive capsules that would aid in the reduction of postoperative edema. The patients did not know if they would be receiving the study drug or the placebo (lactose) capsules. It was further stressed to the patient that the capsules would aid in the reduction of postoperative sequelae (soreness, muscular trismus and so forth). A photograph was then taken of the patient's face and appropriately labeled with the date and a study number. The capsules were dispensed to the nursing station for distribution to the patient during his hospital stay. Twenty-four hours postoperatively a second photograph was taken which again included the patient's clinical number and the date. At this time each of the patients received three postal cards, on the back of which were imprinted questions to be answered on certain days, then mailed to the hospital. The remaining capsules were given to the patients at this time, and they were instructed when to take the capsules.

The questions on the postal cards were worded so that a yes or no answer or the underlining of a word would supply the necessary information. The postal cards were filled out 48, 96 and 144 hours postoperatively.

Two teams of independent personnel who had little or no interest in the results of the study, but who had had medical training, were asked to evaluate the preoperative and postoperative photographs as to whether the patient's face appeared swollen after the surgical procedure. The pictures were evaluated by the teams working independently of each other.

The patients were divided as fol-

Table • Results of study on the use of a combination of prednisolone and vitamin therapy in the control of postoperative edema (percentage values given)

Question	Reply	48 hours			96 hours			144 hours		
		Group 1	Group 2	Control	Group 1	Group 2	Control	Group 1	Group 2	Control
1. Have you taken any medication for pain?	Yes	42.4	51.3	52.0	33.3	48.7	46.0	18.2	29.3	44.0
	No	57.6	48.7	48.0	66.7	51.3	54.0	81.8	70.7	56.0
2. Does your mouth feel sore today?	Yes	45.5	70.7	82.0	54.5	65.9	66.0	42.4	48.7	54.0
	No	54.5	29.3	18.0	45.5	34.1	34.0	57.6	51.3	46.0
3. a. Is your face swollen today?	Yes	78.8	90.3	86.0	54.5	73.2	72.0	27.2	29.3	42.0
	No	21.2	9.7	14.0	45.5	26.8	28.0	72.8	70.7	58.0
b. Has the swelling of your face increased or decreased since yesterday?	Inc.	18.2	29.3	30.0	0	0	2.0	0	0	0
	Dec.*	81.8	70.7	70.0	100.0	100.0	98.0	100.0	100.0	100.0
4. a. Is your face or neck "black and blue" today?	Yes	18.2	24.4	32.0	21.2	31.7	32.0	18.2	26.8	28.0
	No	81.8	75.6	68.0	78.8	68.3	68.0	81.8	73.2	72.0
b. Have the "black and blue" areas increased or decreased since yesterday?	Inc.	0	7.3	16.0	3.0	12.4	4.0	0	0	2.0
	Dec.*	100.0	92.7	84.0	97.0	87.6	96.0	100.0	100.0	98.0
Results of photographs after 24 hours										
Swelling was present										
Team 1	Yes	54.5	53.6	78.0						
	No	45.5	46.4	22.0						
Team 2	Yes	54.5	53.6	84.0						
	No	45.5	46.4	16.0						

*Decreased figures include those patients who reported "no" to the previous question.

lows: 33 patients were designated as Group 1, 41 patients were designated as Group 2, and 50 patients were designated as the control group.

Group 1 received the study medication as follows: two capsules on the evening before surgery, two capsules one hour prior to surgery, two capsules eight hours after surgery and one capsule three times a day for three days, starting on the first postoperative day.

Group 2 received the capsules, two on the night prior to surgery, two capsules one hour before surgery, two capsules six hours after surgery, two capsules 12 hours after surgery and then one capsule three times a day for two days, starting on the first postoperative day.

Part of the control group received placebo capsules on the dosage schedule given for Group 1, and part received them on the schedule for Group 2. There were no differences in the results between the two control groups and therefore these results are grouped together and are presented as a single unit.

■ *Results and Discussion*

The results are shown in the table. The first dosage schedule (that for Group 1) appeared to be more effective than the second dosage regime (that for Group 2).

Whereas all groups showed swelling, the statistics indicate that the group receiving the study medication had a reduction in their edema more rapidly than the control group. It is also pointed out that the additional side effects of the trauma (soreness, pain and ecchymosis) were reduced by the study medication.

The difference in percentage values between those patients who were reported as being swollen at the time of the second picture (24 hours postoperatively) and those who reported swelling 48 hours postoperatively should be noted. Perhaps the concentrated dosage of the medication on the operative day masked the edema, but when the patient started on the smaller dose after discharge the swelling became noticeable. This, of course, is speculative.

■ *Summary and Conclusions*

A new combination of inflammatory suppressive drugs (prednisolone and a water-soluble bioflavonoid compound) was studied in order to test its edema-controlling properties after oral surgery procedures. The patients were divided into three groups: Group 1, 33 patients; Group 2, 41 patients, and a control group of 50 patients. The main difference between Group 1 and Group 2 was in the dosage given to the patient on the operative day. Most of the patients underwent full mouth extractions. Photographic records (preoperative and 24 hours postoperatively) and postal cards filled out and mailed in by the patient were used to complete the records.

The data indicate that those receiving the study medication had a more rapid reduction in edema than the control group. Soreness, pain and ecchymosis were also reduced.

Further work with a combination of water-soluble bioflavonoid compound and corticosteroid drugs should be encouraged by this report.—*101 South Indiana Avenue.*

This study was supported by a grant from the U.S. Vitamin Corporation.

*Formerly, resident in oral surgery, Wheeling Hospital, Wheeling, W. Va.

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■ Forward Motion

Even the biggest idea has to have enough people behind it to give it any forward motion.—*Norman Cousins. Education Against Helplessness, Saturday Review, March 19, 1960.*

VOLUME 18 • JULY 1960 • NUMBER 4

Primary malignant melanoma of the oral cavity: *report of case*

■ *E. G. Friedrich,* D.D.S., and O. V. Renaud,† M.D., Chicago*

Malignant melanomas are the most aggressive of all the malignant tumors. The incidence of malignant melanomas in the oral cavity is very low.

The careful study by Spitz and Allen[1] has shown that malignant melanomas arise from the junctional component of the compound nevus, or the junctional nevus.

The routes of dissemination of the malignant melanomas are to the regional lymphatic vessels and via the vascular routes. The widespread dissemination and distal implants of the tumor are the factors which always clinically classify this as the most aggressive of the malignant tumors.

In an article[2] on five cases gleaned from material available at Walter Reed Army Hospital, the following criteria were set up for the establishment of the disease as primary in the oral cavity: (1) the demonstration of malignant lesions in the oral cavity, (2) the presence of intraepidermal (junctional) activity and (3) inability to demonstrate any other primary site. Only two of the cases reviewed met all these requirements.

In a more recent report,[3] 105 cases of primary malignant melanoma of the oral cavity reported over the last one hundred years were reviewed. The first case on record was reported by Weber in 1859. The most common age group affected is that between 50 and 60 years. The disease appears to occur twice as frequently in males as females. There is an 80 per cent incidence in the maxilla, with the average time between onset and diagnosis being 16.5 months. In 30 per cent of the patients, pigmentation of the mucosa had been present for from a few months to several years. In only 50 per cent of 93 cases considered was clinical evidence of lymph node metastasis reported. Survival averaged 18.5 months after diagnosis and of the total 105 cases reported, only three patients lived more than five years.

A report[4] from the M. D. Anderson Hospital states that 3.5 per cent (479 patients) of all patients with cancer admitted to the hospital had malignant melanoma. Malignant melanoma in the head and neck constituted 24.3 per cent of the total number. Pack, and others,[5] reported their total experience of 1,190 cases of malignant melanoma, 22.1 per cent (263 patients) of which were in the head and neck. The intraocular malignant melanomas were kept separate from those of the head and neck, and totaled 56, or 4.7 per cent. Oronasal-esophageal malignant melanomas accounted for 1.8 per cent (21 patients).

REPORT OF CASE—The patient, a 56 year old white woman, was examined upon the referral of her physician, with a chief complaint of bleeding from a succulent mass of tissue be-

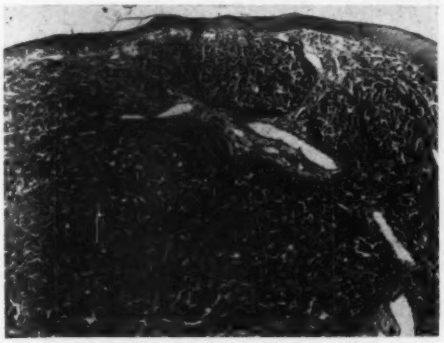

Fig. 1—Biopsy section through tumor. Note invasion of underlying mucosa by cords and masses of malignant epithelial cells. Several large vascular spaces are seen. Covering epithelium is thinned and exhibits some changes in basal cell layer. The tumor is amelanotic in most regions

tween the upper central incisor teeth, upon the slightest contact.

Clinical examination revealed a well-cared-for mouth and an elevated, broad-based tumor between and above the upper central incisors. The tumor seemed to lie beneath a pigmented area and was approximately the width of the two incisors and somewhat narrower in its other dimension. There were numerous pigmented areas along the buccal and labial gingivae of the maxilla which were not elevated and only moderately diffuse. An area on the palate was also pigmented and appeared to fan out from the incisive papilla. There were no other areas of pigmentation in the oral cavity, either on the mandibular mucosa, the floor of the mouth, soft palate or pharynx. A small dark area on the tongue was diagnosed clinically as a hemangioma. No cervical nodes were noted.

The patient said that buccal a labial gingivae pigmentations had been present for nine years, to her knowledge, and that she had noted a variation in the depth of their color and diffusion from time to time. The palatal pigmentation, however, was of recent appearance, because it had not been noted during an oral examination six months previously.

The patient said she had injured the area of the tumor while brushing her teeth six weeks before seeking diagnosis and treatment.

The clinical aspect, succulence, and underlying character of the growth led to a tentative diagnosis of granuloma pyogenicum, and it was decided that an excision biopsy should be performed, to include the pigmentations on either side of the tumor.

Roentgenographic examination of the area revealed normal bone without periodontal disease or radiolucency indicative of invasion.

Under local anesthesia, the tumor was excised together with the pigmented areas on either side to the surface of the underlying bone, including periosteum, and sent to the pathological laboratory for diagnosis based on examination by microscope (Fig. 1, 2). A report was made of malignant melanoma, which was concurred in by Dr. Simonds and Dr. Kent of the staff of Alexian Brothers Hospital, and later by Dr. Tiecke of the Dental School, Northwestern University, and Dr. Arthur Allen of Miami, Florida.

The patient's physician was advised of the diagnosis and he, in turn, appraised the patient of the situation together with the prognosis and indicated treatment. She at first refused a radical procedure, but accepted after consultation.

The treatment of malignant melanoma is wide surgical excision. Malignant melanomas in the oral cavity do not permit as wide a

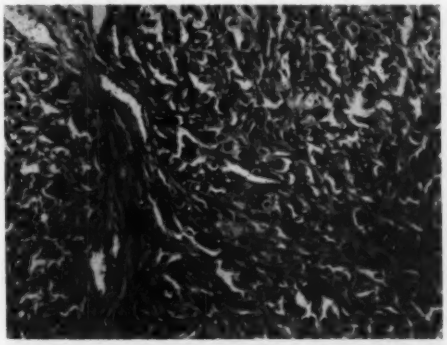

Fig. 2—Tumor cells, showing variation in size and shape of nuclei and in staining quality. Note mitotic figures

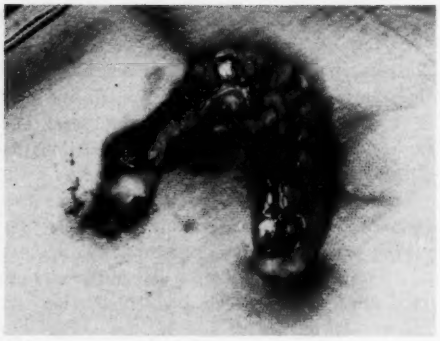

Fig. 3—Gross specimen

margin of resection as do those arising in other regions of the body. Surgery was performed after the diagnosis had been established by excisional biopsy; it was performed through the open mouth, by carrying the line of incision high in the maxillary gingival buccal gutter from the retromolar region on the right to the retromolar region on the left. The line of incision along the hard palate was from the retromolar regions, high on the alveolar ridge, anteriorly and in a line behind the pigmentation in the area of the premaxilla. With the use of a mallet and chisel, the entire upper alveolar process, premaxilla and overlying gingiva were excised (Fig. 3). To correct the surgical defect, a split-thickness skin graft was used, which had been taken from the thigh region before surgery on the oral lesion. Subsequent shrinkage of the graft reduced the reconstructed gutter which was present when the stent was removed from the graft site.

The surgical specimen did not reveal any residual melanoma, although there was evidence of junctional activity in the mucosa of the premaxilla and the entire alveolar ridge (Fig. 4).

DISCUSSION—The pigmented nevi are very sensitive to hormonal stimuli; that is, pituitary, adrenal and gonadal.[6] This patient had received supplementary hormone therapy for approximately two decades; although malignant melanomas are not hormone dependent, it is open to question whether the exogenous estrogen therapy had anything to do with the activity in the junctional layer of the pigmented oral lesions.

Tullis' work, which has associated the production of melanin with dysfunction of the adrenal glands and the complex chemistry of amino acids (tyrosine), coupled with the fact that melanoblasts are to be found everywhere in the epithelium, lead to the proposal that the tumor melanoma may be present at least subclinically everywhere at the time of onset, and that the claim of initial lesions in the oral cavity is made merely on the basis of clinical observation.[7]

The relationship of malignant melanomas arising in the junction nevi, and subjection to repeated trauma, cannot be overlooked. The patient practiced good oral hygiene, and the possibility that trauma to the gingiva at the time of brushing the teeth may have contributed to the junctional activity and subsequent melanoma should be considered.

Regardless of the possibly nebulous contributing factors in this specific case, there is one irrefutable statement: pigmented areas arising in the oral cavity which are subject to repeated trauma or which are increasing in size or darkening of pigmentation, or both, should be totally excised and carefully assayed microscopically. The relationship of pig-

Fig. 4—Section from pigmented area of gross specimen. Note junctional activity. Small cords of nevus cells are in the submucosa

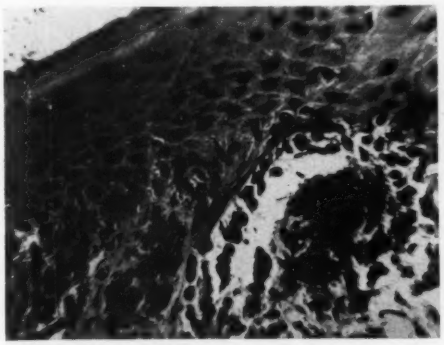

Fig. 5—Early invasive melanoma of the mucous membrane. Large, pigmented cells are seen in this section immediately beneath, and in contact with, the covering epithelium

mentation of the mucous membrane of the oral cavity and familial polyposis of the intestinal tract should be mentioned; appropriate investigations should be made to establish the diagnosis of Putz-Jaeger disease and the institution of appropriate treatment.

CONCLUSION—As so few instances of primary melanoma of the gingivae are reported, little is known of the behavior of this disease. Since knowledge of melanoma is based on its behavior elsewhere, and since these and other tumors behave differently in the oral mucosa, it is hoped that the description of the behavior of the tumor in the case reported will add to the knowledge of the disease and treatment of future occurrences.

ADDENDUM—Since this article was first submitted for publication, the patient has been observed at 30 day intervals. Four months after surgery, a very small area of pigmentation was noted on the lateral edge of remaining palate; it continued to expand and darken until it was 4 by 6 mm. This area was removed and sectioned, the report being "early invasive melanoma of mucous membrane," with a further note that the lesion "has the characteristics of a primary lesion rather than being metastatic from the original;" this suggests a multicentric process, a thought advanced by Allen and Spitz, and is in agreement with the hypothesis mentioned in the body of this article. Allen refers to the lesion as a superficial melanocarcinoma; the description of this disease, based on examination by microscope, is similar to that received from the pathologist describing the section taken from this patient (Fig. 5).

On April 4, 1960, some 19 months after the initial diagnosis, the patient was hospitalized, and placed under treatment for diffuse metastatic carcinoma of the lungs. The diagnosis was based on serial roentgenographic studies. The present treatment consists of 100 mg. cyclophosphamide (Cytoxan) daily, with no noticeable response.[8]

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†Supervising staff surgeon, Alexian Brothers Hospital and attending surgeon, Augustana Hospital.

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Plastic repair of a traumatic oroantral defect: *report of case*

■ *Harold E. Boyer,* D.D.S., M.Sc.D., Louisville, Ky., and Jack H. Beckwith,† D.D.S., Miami, Fla.*

The repair of oroantral defects is a difficult surgical problem. The prognosis is influenced by the size of the defect and by the presence of infection in the antrum. This case is reported because of the unusually large infected maxillary defect that was repaired successfully.

HISTORY—On January 19, 1956, a 53 year old white man was admitted to the oral surgery service at Jackson Memorial Hospital, Miami, Fla., with the diagnosis of a traumatic oroantral defect.

On December 22, 1955, the patient had been involved in an accident and had fallen, striking the right side of his face on a concrete post. He stated that several teeth had been knocked out at the time of the accident but he had been in no acute distress. The patient had been placed under arrest and held in jail.

During the three week period of confinement the patient had not sought medical care. He stated that his face had become swollen, ecchymotic and extremely painful at times. He had removed several loose teeth and several large pieces of bone from his maxilla. Several days later, he experienced difficulty in talking and eating, and on examination of his mouth he noticed a large defect in his right maxilla. By placing a wad of chewing gum in the defect, he was able to drink water without having it come out through his nose.

On January 12, 1956, the patient reported to the oral surgery outpatient clinic for treatment. He held five teeth and several bony fragments in his hand as he gave the preceding history (Fig. 1, above left). He admitted that he had not sought treatment until the facial pain became severe. The nasal tone in his speech, together with the difficulty in eating and drinking, made him apprehensive, and he was now receptive to treatment.

The past medical history was essentially negative and noncontributory. The patient was blind in the right eye and suffered a loss of ocular coordination as a result of an old eye injury.

ORAL AND FACIAL EXAMINATION—The most obvious intraoral finding was the defect in the right maxilla (Fig. 1, above right). The defect was extensive, measuring approximately 3 cm. by 5 cm. and involving the entire floor of the right antrum. It extended from the right lateral incisor region to the right second molar region, and from the mucobuccal fold on the right side to approximately 1 cm. from the midpalatal line.

The tissue margins of the bony defect were secondarily infected, and elevations of erythematous, hypertrophied tissue projected into the wound. The cavity was coated with purulent material and had a foul odor.

Extraorally the face was symmetrical with no evidence of bony expansion or soft tissue swelling. The submaxillary and cervical lymph nodes were not palpable.

Fig. 1—Above left: Teeth and bony fragments brought by patient on initial visit. Above right: Maxillary defect prior to surgery. Below left: Antral dressings used to close defect during conservative treatment in preparation for surgical procedure. Below right: View with antral dressing in place. Note extent of defect. Bismuth iodoform paraffin paste used to coat iodoform dressing appears radiopaque

PREOPERATIVE TREATMENT—On January 12 the defect was irrigated with hydrogen peroxide and saline solution. Tissue from the palatal margin of the defect was taken for biopsy. The pathological examination revealed that the oral mucosa showed subacute inflammation and atypical epithelium. The report was negative for tumor. Lateral skull films and posteroanterior films showed bone erosion of the right maxilla. The wound was packed with iodoform gauze coated with bismuth iodoform paraffin paste and sutured in position. The patient was started on daily penicillin therapy.

On January 17, the patient returned to the clinic. The defect was again irrigated and a section of tissue from a projecting mass in the antrum was taken for biopsy. The biopsy revealed that the condition was compatible with nasal (antral) polyp, chronically inflamed with squamous metaplasia.

A new pack was sutured in the defect. Figure 1, below, shows the defect with the antral dressings.

On January 19, the patient was admitted to the oral surgery service. Laboratory examinations were carried out. The results of a complete blood count and urinalysis were essentially normal. The serological examination was nonreactive. Physical examination showed that the patient's blood pressure was 200/120; the pulse was 72, and respiration was 18. The remaining physical findings were noncontributory. The results of the oral and facial examination have been given previously. As a result of these examinations and studies, the following impressions were noted:

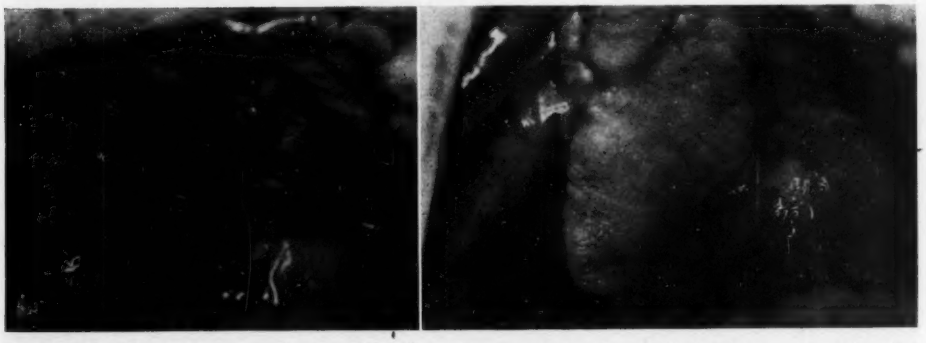

Fig. 2—Left: View after removal of acrylic splint. Sutures are in place and dressing covering denuded bone can be seen in midline of palate. Right: Postoperative view March 13 shows surgical result

1. An oroantral defect was present in the right maxilla.
2. The patient had hypertension.
3. The likelihood of a maxillary tumor was ruled out.

On January 20, an impression was made of the maxilla, and a stone cast was constructed. Paper cutouts were used to determine the best possible flap procedure for closure of the defect. A technic utilizing both a cheek flap and a bipedicle sliding palatal flap was devised. An acrylic palatal splint was fabricated and lined with zinc oxide-eugenol cement. The splint was used to support the flap after surgery.

On January 22, the dressing was removed and the wound was irrigated. The color of the marginal tissue had improved and the patient was ready for surgery. Medical consultation was requested in view of the patient's hypertension and the patient was cleared for surgery.

On January 24, the patient was taken to surgery. A pathological examination on this date revealed acutely and chronically inflamed granulation and fibrous tissue.

SURGICAL PROCEDURE—The patient was anesthetized with cyclopropane-oxygen-thiopental sodium-succinylcholine chloride, with endotracheal intubation. An incision was made around the entire edge of the defect, excising the margin of granulation tissue and creating a fresh edge for approximation. A second incision was made to the left of the midline extending in a semilunar fashion from the midline of the posterior border of the hard palate across the left side of the palate to a point 0.5 cm. posterior to the anterior palatine foramen. The palatal mucoperiosteal flap was then elevated, making the flap mobile so that it could be slid across a portion of the defect. The buccal mucosa was then dissected free from the cheek so that a cheek flap could be brought across the defect and approximated with the sliding palatal flap.

A window was made below the right inferior nasal concha opening from the nose into the antrum. The antrum was then packed with iodoform gauze, inserting the end of the packing through the window into the nose, and gently lacing the packing across the maxillary defect until the defect was filled. The flaps were approximated and sutured. The suture line was everted with deep mattress sutures to get the maximum tissue contact at the line of approximation. The previously prepared acrylic splint was inserted and wired to the remaining maxillary teeth.

The patient tolerated the procedure well and left the operating room in satisfactory condition.

POSTOPERATIVE COURSE—The patient had an uneventful postoperative course. In addition to the routine postoperative orders the patient

was started on tetracycline hydrochloride therapy (250 mg. every six hours).

The first postoperative day the patient experienced only slight facial swelling. He was comfortable with the palatal splint and was able to speak and eat normally.

On the sixth postoperative day 4 feet of the iodoform packing was removed through the nose, and on the seventh postoperative day the remaining packing was removed and the antrum was irrigated. The palatal splint was removed and the incision line was found to be healing well (Fig. 2, left).

On the eleventh postoperative day the antrum was again irrigated and clear fluid was recovered. The incision showed no evidence of breakdown, and all sutures were removed except the deep mattress sutures.

On February 5 (the twelfth postoperative day) the patient was discharged from the hospital feeling comfortable. Tetracycline hydrochloride therapy was continued, and the patient was followed in the outpatient clinic.

On February 7, the remaining sutures were removed, and the patient continued to progress satisfactorily. The patient's final visit was on March 13. The wound had healed completely with no evidence of fistula formation (Fig. 2, right). The patient was discharged from the oral surgery service.

COMMENTS—This case was interesting, and the surgical result was satisfying to both the patient and the surgeon. Several complicating factors are worthy of comment.

1. It was rather difficult to accept the patient's history and assume that the large maxillary defect was the result of a traumatic injury. The possibility of bony erosion by an invading tumor with superimposed trauma was seriously considered in the differential diagnosis. The surgeon had to be convinced by two negative biopsy reports that the defect was free of tumor before he would proceed with the surgical repair of the defect.

2. The intraoral wound was three weeks old and grossly infected when treatment was first started. Unless the infection could be eliminated prior to the surgical closure, the prognosis of any flap procedure would be extremely poor. Conservative treatment of the defect with frequent irrigations and antibiotic therapy reversed the infectious process.

3. One of the cardinal principles in designing a good flap is that the suture line be supported by bone. The defect in this case was extensive, and it was situated in a position that made it impossible to rotate a single flap that would cover the defect and place the suture line over bone. Therefore, a technic was used that utilized a cheek flap and a bipedicle sliding palatal flap with the suture line unsupported by bone. However, the flap was supported by the iodoform gauze packing in the defect and by the acrylic splint on the palate. It is the opinion of the surgeon that the everted approximation of the tissue flaps with deep mattress sutures, permitting a wide tissue contact, was one of the most important factors in the success of the repair.

SUMMARY—A 53 year old white man was seen in the oral surgery clinic at Jackson Memorial Hospital, Miami, Fla., with a large oroantral defect in the right maxilla. The defect was a result of a traumatic injury of the right side of the face, displacing the teeth in the right maxillary arch and exposing the right maxillary sinus. The defect was untreated for several weeks and it became grossly infected.

With conservative treatment by irrigations and antibiotic therapy, the infection was eliminated. A technic utilizing a bipedicle sliding palatal flap and a cheek flap was devised to close the defect. The flap was supported with the antral packing and a palatal acrylic splint.

The operation was successful, permitting the patient to enjoy normal speech and eating habits.

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Unusual foreign body in the tongue: *report of case*

■ *William B. Linenberg,* D.D.S., and H. James Harpole,† D.D.S., Atlanta, Ga.*

The finding of a brass BB shot within the transversus linguae muscle of the tongue is sufficiently unusual to warrant reporting of the following case.

A Negro woman, 35 years old, was referred from the emergency clinic to the dental clinic of Grady Memorial Hospital. The referring physician noted evidence of infection and the point of entry of a round, ball-like object which passed through the mucosa of the dorsum of the tongue. However, he was unable to observe any point of exit.

The patient stated that five days prior to admission she had shot herself in the mouth with a BB gun as she was cleaning it. For the next three days she experienced no pain, but on the fourth day she began to have pain, particularly during mastication.

On examination, a small punctured area (2 mm. in diameter) with an inflamed margin and purulent exudate was seen midway between the midline and lateral border of the dorsum of the right side of the tongue approximately 3 cm. from the tip. Pain could be elicited by manipulation of the tongue. Palpation was negative. The tongue was grossly fissured.

Occlusal-sized roentgenograms showed no evidence of a foreign body. Periapical-sized films were placed under the right side of the tongue and the tongue was extended as far forward as possible. A round radiopaque body was noted that was near the midline of the tongue.

OPERATION—A 2 per cent solution of lidocaine hydrochloride containing epinephrine was used for bilateral lingual nerve blocks. A 2 cm. incision was made through the mucosa extending posteriorly from the point of entry. The pathway of entrance of the foreign body was used as a guide (Fig. 1). A straight mosquito hemostat was used for blunt dissection. After several minutes of probing, a 27 gauge needle was placed in the region and a roentgenogram made. This showed the object to be near the midline. The needle was reinserted

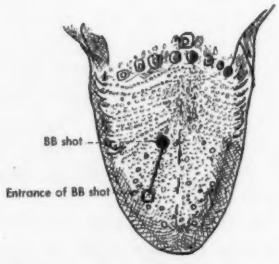

Fig. 1—Dorsum of the tongue showing point of entrance of BB shot and outline of projected course

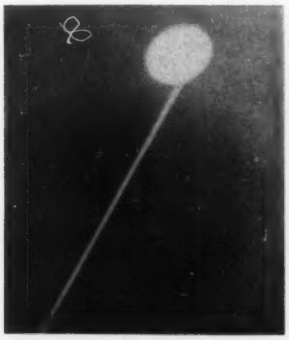

Fig. 2—Needle tip can be seen over foreign body

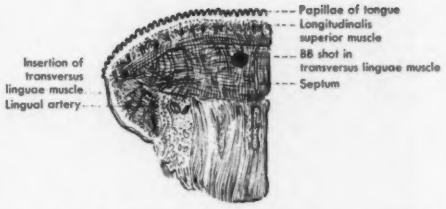

Fig. 3—Coronal section of tongue showing position of BB shot in transversus linguae muscle

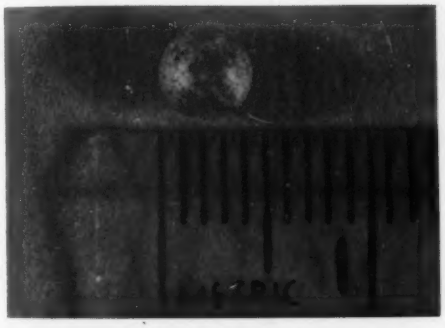

Fig. 4—Foreign object

Fig. 5—Sutures in place two days postoperatively

in the direction of the midline and a roentgenogram revealed the tip of the needle over the foreign body (Fig. 2). Probing of the region and blunt dissection exposed the foreign object. It was within the transversus linguae muscle (Fig. 3, 4). The wound was irrigated with a normal saline solution and the muscle fibers were closed with no. 000 catgut interrupted sutures. The incision was closed with no. 000 black silk interrupted sutures.

Postoperatively, penicillin therapy was instituted, and the patient was instructed to use ice chips in the first 24 hours to minimize edema of the tongue. The postoperative course was uneventful with the exception of a minor amount of swelling.

The sutures were removed on the fifth postoperative day (Fig. 5). The patient was comfortable and free from pain.

SUMMARY—A Negro woman was seen who had shot herself in the mouth with a BB gun as she was cleaning it. The foreign object was removed from the tongue by a relatively simple procedure.

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Juvenile hemangio-endothelioma: *report of a case*

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The juvenile hemangio-endothelioma is a rare oral tumor. It has a tendency to recur, particularly with repeated conservative surgery. Malignant transformation sometimes occurs.

HISTORY—A nine year old white girl had first noticed a lesion on the labial gingiva between the mandibular central incisors in the winter of 1956. The lesion was excised by her family dentist. By spring of 1956, the lesion had recurred (Fig. 1, above). She was referred to the division of oral surgery, College of Dentistry, Ohio State University Health Center, where an excisional biopsy procedure was carried out. The histopathological diagnosis was hemangio-endothelioma. Two weeks later, the lesion was excised more deeply by electrocautery.

In the summer of 1957 the lesion recurred again, and another excisional biopsy procedure was performed. The same histopathological diagnosis was made. After five weeks, the lesion had recurred again and the patient was admitted to the oral surgery service, University Hospital (Fig. 1, below).

PHYSICAL EXAMINATION—During oral examination a red, spongy mass was seen on the labial aspect of the mandibular gingiva between the central incisors. Some of the tumor mass protruded onto the lingual aspect. The general physical examination, roentgenograms and the routine laboratory studies showed a normal, healthy, nine year old girl.

OPERATION—While the patient was under general anesthesia a labial horizontal incision was made from the left cuspid to the right cuspid 2.5 cm. below the gingival margin. It was extended upward across the gingival papilla and to the lingual mucous membrane in the floor of the mouth about 5 mm. from the lingual reflection. The incision was extended across the floor of the mouth to the left side and then forward up the attached gingiva to the cervical region of the left cuspid. It was connected with the original point of incision on the labial aspect.

Flaps were elevated labially and lingually away from the lesion. A block of mandible, four incisors and oral mucosa from the left to the right cuspid at a level just below the apexes of the incisors was removed. The entire mass was submitted as a biopsy specimen. Carnoy's solution was used to control bleeding. A sliding flap was moved from the lip and the defect closed with no. 0000 silk sutures.

POSTOPERATIVE COURSE—The hospital course was uneventful, and the patient was discharged from the hospital four days postoperatively. She was seen postoperatively at regular intervals in the oral surgery clinic. There has been no recurrence of the lesion after 23 months. Postoperative views of the patient are shown in Figure 2.

REPORT OF PATHOLOGIST—The gross specimen consisted of a block of mandibular bone

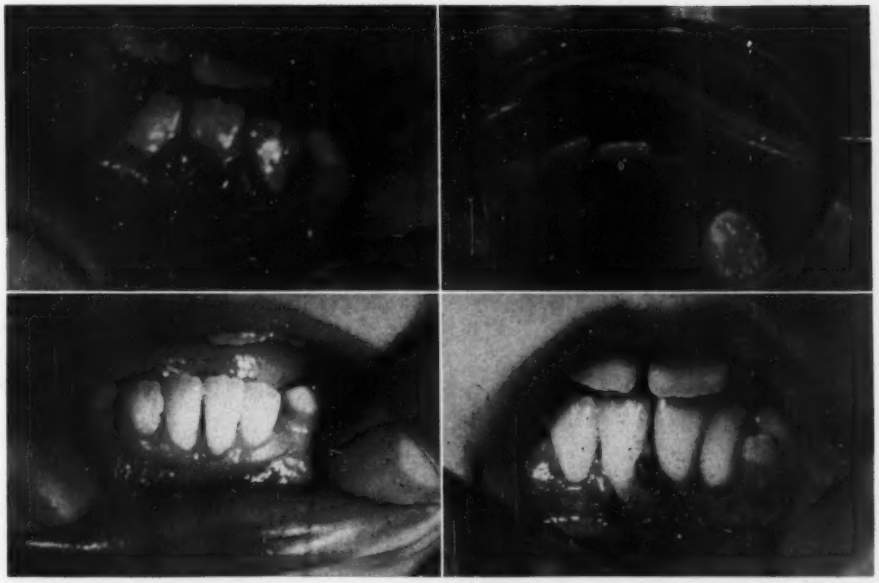

Fig. 1—Above left: Clinical appearance of lesion. Above right: Lingual aspect. Below left: View three weeks after conservative surgery. Below right: Recurrence of lesion after five weeks

Fig. 2—Postoperative views. Above left: Twenty-four hours after block resection. Above right: Eighteen months after block resection. Below: Prosthesis in place

Fig. 3—Gross specimen

covered with oral mucosa and containing four incisors (Fig. 3). There was a hemorrhagic, red, tumorlike mass extending labially and lingually around the cervical region of the central incisors.

The microscopic examination showed that sections of the gingiva revealed a fairly discretely outlined mass of closely packed spaces lined by endothelial cells, many of which appeared mobilized, and many of which had large vesicular nuclei with hyperchromatic peripherally placed chromatin and prominent nucleoli. At one point, this process appeared to penetrate through the limiting capsule. The lines of surgical excision were well outside the tumor.

The diagnosis was juvenile hemangio-endothelioma of the gingiva. The alveolar bone showed chronic osteomyelitis. The lines of excision were free of tumor.

DISCUSSION—Hemangio-endothelioma was first reported in 1899 by Borman and is most generally referred to as low grade malignant neoplasm.[1] It may occur anywhere, but mostly in skin, subcutaneous tissue, bone, liver and spleen.[2] Oral lesions are uncommon.[1] Its appearance is flat or slightly raised, bluish red in color, sometimes ulcerated with a tendency to bleed, even with the most minute trauma.

Histologic features are masses of endothelial cells in columns with poorly defined blood vessel formation.[3] The cells themselves are polyhedral with faint outline and round nuclei with multiple minute nucleoli.[1] Mitotic figures are not constant, frank anaplasia is not present, and there is little evidence of variability in nuclear or cell size. The cells may grow in whorls or in undifferentiated sheets.[4] The vessels give rise to strands of occluded endothelium, disconnected from the blood stream, which continue to proliferate.

Tumors that form capillary spaces or lumina with hyalinelike material seem more benign than are cellular tumors which are likely to metastasize.[1] The former group includes the congenital or infantile (juvenile) forms. The tumor in the case reported was of this type. They are usually benign,[1] although malignant transformation may occur.[4]

Some authors refer to the hemangio-endothelioma as a malignant epithelial tumor[2,3] except in its congenital or juvenile form.[1] However, this sometimes leads to confusion, and Robbins' designation of the malignant counterpart as a hemangio-endotheliosarcoma[4] is a more precise classification.

As was shown in this case report, even the juvenile form of this tumor is very likely to recur with less than aggressive surgery. This patient was treated conservatively three times in 15 months and the tumor recurred three times. After more radical surgery was performed, there was no recurrence for 23 months.

SUMMARY—A case of juvenile hemangio-endothelioma has been reported. The lesion had been excised three times in 15 months and had recurred three times.

A block resection of the mandible, including teeth and gingiva, was performed. There has been no recurrence after 23 months. The histopathological sections showed the lines of excision to be free of tumor.

There was never any evidence of bony change on the dental roentgenograms. The report of chronic osteomyelitis on the pathologist's report probably represents response to recent surgery.

Juvenile hemangio-endothelioma is considered to be a benign tumor. However, there is a high rate of recurrence, especially with

repeated conservative surgery. Lesions of this type must be excised widely, together with adjacent normal tissue, if favorable results are to be accomplished.

The opinions or assertions contained herein are those of the author and are not to be construed as official or as reflecting the view of the Department of the Air Force or the Air Service at large.

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Mucoepidermoid carcinoma of the palate: *report of a case*

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†Resident in oral surgery, University Hospital, Ohio State University Health Center.

Tumors of the palate are seen frequently during routine oral examination. Definitive diagnosis of these lesions is established by microscopic examination. Palatal tumors frequently arise from salivary glandular tissue. This report is concerned with a mucoepidermoid tumor of the palate.

HISTORY—A 14 year old white girl was admitted to the oral surgery service at University Hospital (Ohio State University Health Center) with a complaint of "a lump in the roof of the mouth." The palatal mass had been discovered previously on routine examination. The duration of the lesion was undetermined.

PHYSICAL EXAMINATION—The patient was a normal healthy girl. The only pathosis was a firm, well circumscribed mass, approximately 2 cm. in diameter, which was observed on the right side of the soft palate (Fig. 1). It extended 1 cm. posterior to the vibrating line and approximately 2 cm. lateral to the midline. It was bluish red and asymptomatic.

Results of routine laboratory examination were within normal limits.

OPERATION—During general anesthesia, a horizontal palatal incision was made which extended 2 cm. anterior and 0.5 cm. posterior to the vibrating line. The tumor mass was exposed through this incision and freed from the surrounding tissue (Fig. 2). It apparently was encapsulated, and it was excised with a wide margin of normal tissue. The tumor bed was cauterized with electrocautery, surrounding tissue undermined, and the wound closed.

HISTOPATHOLOGIC REPORT—The following was taken from the patient's chart. The gross examination was reported as follows: "One-half of a gray-pink nodule 12 x 10 x 10 mm. well encapsulated. Centrally firm yellow tissues."

The microscopic examination was reported as follows: "Sections show squamous epithelium immediately overlying a large, circumscribed, cellular mass from the connective

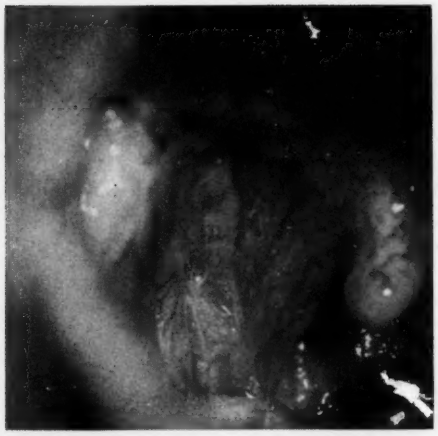

Fig. 1—Preoperative view of mucoepidermoid tumor showing irregular surface of palatal lesion

tissue capsule of which long and short fixed strands of mixed tissue divide tumor mass into irregular sized nodules. Scattered throughout the cellular mass one observes cystic spaces of variable size and other more solid areas. Separated from one portion of the cell mass by connecting tissue strands one observes normal appearing salivary gland tissue. Some of the smaller cystic spaces contain a homogeneous densely eosinophilic material. High power examination shows the masses to consist of cells which in the more solid areas are arranged in a mosaic fashion showing prominent cell walls. In many of the cells the cystoplasm is deeply eosinophilic while in others it is absent and gives a vacuolated appearance to the cells. In general the cells show gland formation though in the more solid areas no gland lumen is evident. The nuclei are variously shaped, being either spherical or horseshoe shaped. The nuclear membrane is prominent, thick and the majority of the nuclei are pale or more vesicular and contain one or two prominent nucleoli. Though there are occasional hyperchromatic nuclei, mitotic activity is not conspicuous" (Fig. 3).

The diagnosis was mucoepidermoid carcinoma of the palate.

POSTOPERATIVE COURSE—There were no complications after surgery, and the patient was discharged on the second postoperative day. Periodic examinations have been made. There has been no recurrence of the tumor after 25 months (Fig. 4).

DISCUSSION—The status of the mucoepidermoid tumor has been confused. Early reports of it,[1,2] as a distinct neoplasm, were made. In 1945 Stewart, Foote and Becker[3] reported the first study of a series of mucoepidermoid tumors. They grouped them into benign and malignant categories according to the histopathologic findings and clinical behavior of the neoplasms. Some of the "benign" tumors had recurred locally but none had metastasized. In a later publication Foote and Frazell[4] reported that three of the tumors previously classified as benign had metastasized. Eventually they urged a change of attitude regarding classification of mucoepidermoid tumors. They felt that benign and malignant classification was possibly too sharp a delineation. To them it appeared more logical to consider all mucoepidermoid tumors malignant; however, to group them grossly as of low or high malignancy, and microscopically as of low, moderate and high malignancy. Others[5] agree with this attitude and believe it

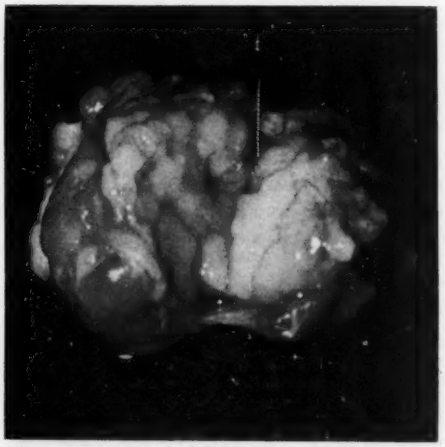

Fig. 2—Gross specimen of tumor

advisable to group mucoepidermoid tumors as being malignant or potentially malignant.

Some of the confusion regarding the status of this tumor undeniably has been caused by a lack of knowledge of the neoplasm. Because of the complexity of histologic findings, it is difficult in some instances to establish a definitive diagnosis of benign or malignant.[5] An additional obstacle is the inability to predict accurately the clinical course of the benign type. The three instances of metastasis already cited are an example of this. Furthermore, these "benign" types can and do occur. Recurrent lesions appear more aggressive and infiltrative. Thus, the argument is tenable that mucoepidermoid tumors should be classed as malignant (low grade and high grade) and potentially malignant.

Among neoplasms, the mucoepidermoid tumor is a relatively common occurrence. About 6 per cent of them have been found in major salivary glands and 90 per cent have been seen in the parotid gland.[3] Tumors of the minor salivary glands have been reported as occurring in 26 per cent and 30 per cent.[5,6] It becomes obvious, then, that the mucoepidermoid tumor is a clinical problem not only because of its natural course but also because of its apparent frequency.

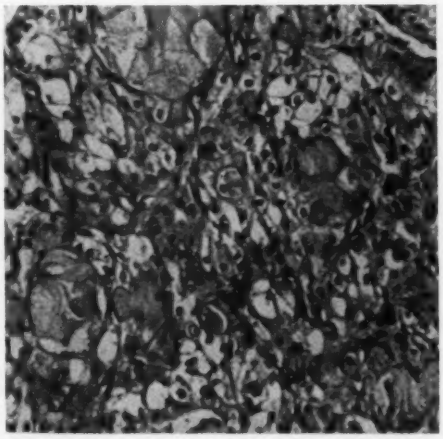

Fig. 3—Photomicrograph showing fairly well differentiated mucoepidermoid tumor with rather liberal number of both epidermoid and mucus-secreting cells. Note positive mucicarmine staining. Micromucocystic areas are seen at upper and lower left corners

Fig. 4—Postoperative view showing healed site of right side of soft palate 18 months later

Mucoepidermoid tumors are probably of ductal origin.[5] Three cell types are most commonly seen. These are mucus-secreting cells, epidermoid cells and intermediate cells. Gross and microscopic features of the mucoepidermoid tumors have been well reviewed.[4,5]

Grossly, the low grade malignant tumor is moderately firm and rather well circumscribed. Encapsulation occurs but usually is incomplete. Some tumors show no encapsulation. Many are cystic with some tumors being extensively so. The cystic spaces generally contain a viscous to thin mucinous fluid. When cut, such tumors become less firm. The low grade type is slow growing and averages 2 to 3 cm. in diameter, not to exceed 5 cm. Usually no pain is experienced.

The highly malignant tumor is quite firm, not well circumscribed and poorly encapsulated. It exhibits infiltrative growth. Cysts generally are not seen. It grows more rapidly and generally is a larger tumor than the average low grade variety. It usually does not exceed 10 cm. in diameter. They are more frequently painful.

Microscopically, considerable pleomorphism is seen throughout all grades of tumors. In low grade tumors the mucus-secreting cell and the polyhedral epidermoid cell are seen in considerable numbers. The smaller, ovoid intermediate cell is seen in moderate numbers and is rarely predominant. The mucus cells actively secrete mucus, thereby resulting in frequent cyst formation. Mucus fluid may "spill" into the fibrous stroma, evoking an inflammatory reaction. The epidermoid cells are dispersed throughout the mass in sheets, cords or circular islands. They do not stain with mucicarmine and though they appear in aggregate as epidermal epithelium, no spinous processes are seen. The intermediate cells are prone to be close to ductal structures. Admittedly, this tumor (low grade), is well differentiated. The high grade malignant tumor is more anaplastic. The epidermoid and intermediate cell types are most abundant. In some lesions the intermediate cell is exceedingly dominant. The nuclei of the latter cells are usually more hyperchromatic. Mucous cells are few and do not actively secrete mucus, if at all. Few, if any, cystic spaces are evident. In some instances a predominant epidermoid component may be seen as squamous cell carcinoma. Anaplastic areas are reminiscent of transitional cell carcinoma.[4]

The sharp distinction and separation of the mucoepidermoid tumor into benign and malignant groups probably is continued by some authorities. It seems prudent that particularly the low grade malignant lesion (that is, the potentially malignant and the "benign" type) be handled more aggressively surgically than is the usual practice when removing unequivocally benign tumors (fibroma, papilloma, lipoma, and so on). A simple enucleation procedure is likely to be inadequate. At least a relatively wide margin of excision (as dictated by the clinical problem) should be employed.

SUMMARY—A mucoepidermoid carcinoma of the palate was removed from a 14 year old white girl. The origin, histologic characteristics, clinical behavior and the classification of the mucoepidermoid tumor are reviewed. Twenty-five month follow-up indicates no evidence of recurrence. The low grade malignancy should be handled more aggressively surgically than is the usual practice when removing unequivocally benign tumors.

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‡Resident in oral surgery, University Hospital, Ohio State University Health Center.

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■ GENERAL ANESTHESIA IN DENTAL PRACTICE. By Leonard M. Monheim. 461 pages with 114 illustrations and 26 tables. Index and references. $10.50. St. Louis, C. V. Mosby Co., 1960.

The anesthetic procedure for the dental outpatient whether done in a chair or on an operating table poses many problems which are not seen in routine hospital cases. With this in mind, Dr. Monheim has followed his work on local anesthesia with a book that should fill a long-standing need. The author is a dentist who has devoted his professional career to the study and practice of anesthesia in a large hospital center. He has, for many years, trained graduate students in the administration of general anesthesia for dental outpatients and hospital inpatients. With this background he is well qualified to speak as an authority on dental anesthesia. Anatomy and physiology of respiration, circulation, and the nervous system, which are so vital to the education of the anesthetist, are outlined in a practical form which includes an excellent chapter on the circulation by Dr. A. J. Fisher of the University of Pittsburgh.

The book received valuable contributions from Dr. George Thomas of the University of Pittsburgh, School of Medicine, who is widely known for his demonstrations of the fire and explosion hazards in anesthesia. Pediatric anesthesia is discussed by Dr. Joseph Marcy of Children's Hospital of Pittsburgh and the legal aspects are covered by Neal Harper, D.D.S., L.L.B., of Ohio State University. This edition is supplied with adequate and excellent pictures and illustrations dealing with such important points as maintenance of the airway, placement of an oropharyngeal partition, and so forth. It is pointed out that the routine intubation of the patient in the office is not recommended, but that the anesthetist should be adept at this procedure should the occasion arise when intubation is necessary.

The chemistry and pharmacology of the various anesthetic agents and other drugs used is complete and up to date with agents such as Methohexital and Fluothane being included. Preanesthetic evaluation and preparation and postanesthetic care are vital parts of the procedure and should not be minimized in the training of the dental anesthetist.

The chapter on the technical aspects of anesthesia is especially interesting and in it the author outlines various technics of administration including the "Chemanesia" technic to be used for longer procedures in the office and on poor risk patients who otherwise could not be treated.

The purpose of the book is to be used as a reference text for graduate students and trained dental anesthesiologists. It is not primarily designed as a guide for undergraduate students because it is felt that postgraduate practical and theoretical training is mandatory for the safe administration of general anesthesia in the dental office.

Dr. Monheim's book is an extremely interesting and readable one, presented in an orderly and straightforward manner and should be a valuable addition to the shelf of the dentist who utilizes general anesthesia.—*David L. Ford.*

■ PATHOLOGIC PHYSIOLOGY OF ORAL DISEASE. By Richard W. Tieke, Orion H. Stuteville, and Joseph C. Calandra. 480 pages with 637 illustrations. Index. $11.50. St. Louis, The C. V. Mosby Co., 1959.

The authors have done a most commendable job in gathering a wealth of up-to-date information in a well organized presentation of the pathology of the oral cavity and associated

structures. Clear illustrations, which are a vital part of a text in this field, are present in abundance. An attempt is made to correlate the clinical features of the various disease states with the microscopic patterns through discussion and photographic studies. In most instances, however, the histopathologic description is too brief and unimaginative to convey the intended correlation. One is left with the impression that more could have been done along these lines.

All of the more common maladies and nearly all of the less common ones are presented in a fashion which will provide the reader with a clear picture of the important considerations of a given disease. The emphasis is placed squarely on practical information and little or no consideration is given to alternatives or theories. This is a defensible position, if not the most idealistic. Although the coverage is admirably thorough, the style is terse and encyclopedic. This provides a very adequate text for on-the-spot reference, but leaves something to be desired in the way of relaxed and enjoyable reading.—*Edward P. Henefer.*

■ ENDODONTIC PRACTICE. By Louis I. Grossman. 402 pages with 143 illustrations. Fifth edition. $7.50. Lea & Febiger, Philadelphia, 1960.

The title of this book has been changed from *Root Canal Therapy* to *Endodontic Practice;* however, the sequence of editions has been maintained.

The addition of many references to the current literature has brought the book up to date. The chapter concerned with focal infection appearing in the fourth edition has been omitted. The section on antibiotics has been enlarged.

The book can be divided into four sections. The first section deals with clinical diagnostic methods and diseases of the pulp and periapical tissues. The second part is concerned with vital pulp therapy. The third section includes ten chapters describing the technic of root canal therapy. A description of pulpectomy procedures, selection of cases, principles of therapy, and anatomy of the pulp cavity serve as an introduction to the next five chapters dealing with preparation, irrigation, sterilization, culturing and filling the root canal. The last segment of the text is concerned with root resection, treatment of traumatized teeth and bleaching discolored pulpless teeth.

The book will be most useful as a textbook for undergraduate and postgraduate students and would make an excellent reference work for the practitioner who is interested in endodontics.—*William F. Via, Jr.*

■ REPORT WRITING IN DENTISTRY—A TEACHING OUTLINE. Edited by J. K. Avery, A. L. Bader, R. G. Faucher, H. L. Johnson, F. E. Moore, R .E. Moyers, F. A. Peyton, and K. A. Easlick. 70 pages. Bibliography. $2.25. Ann Arbor, Mich., Overbeck Co., 1959.

This booklet is a guide to preparing and writing scientific articles. Now in its ninth edition, it has been expanded by the inclusion of additional detailed information and altered by the revision of several sections.

Described in the first portion of the booklet are the procedures for efficiently collecting and critically appraising published information. In the second and third parts, the features of a well planned investigation and the technics of developing a good scientific report are discussed. Information concerning acceptable forms for reporting journal and book references is included and basic abbreviations for periodicals are listed. A segment of the manual, devoted to instructions for thesis work, is presented mainly in terms of the requirements at the University of Michigan and therefore serves primarily a local interest. A bibliography of 112 references offers a rich source for further reading.

Although basically designed for dental students, the contents of this manual are timely for any individual writing in the field of dentistry.—*William K. Elwood.*

■ A Clinicopathologic Study of 43 Cases of Glandular Tumors of the Tongue. Paul Burbank, D.M.D.; Malcolm Dockerty, M.D., and Kenneth Devine, M.D. Surg., Gynec. & Obst. 109:573 Nov. 1959.

Forty-three glandular tumors of the tongue, many of which had been previously diagnosed as mixed tumors, were classified into four groups on the basis of their histologic pattern. Cylindromas accounted for 51 per cent of the series. They were characterized clinically by pain; however, the duration of this symptom was relatively long (two years) before the patients sought treatment. Local fixation of the tumor to the underlying musculature of the tongue was a feature, as was the surgical observation that these tumors were infiltrative. Pathologically, the infiltrative tendency was considerable, as was the predilection to extend into the perineural spaces. This group of neoplasms presented the most unfavorable prognosis.

Mucoepidermoid tumors, heretofore only rarely described as appearing on the tongue, constituted almost 26 per cent of this series. This group was the most favorable one encountered from the standpoint of prognosis, with the exception of the mixed tumor group. Surface ulceration of the overlying mucosa tended to occur. Adenocarcinomas constituted 21 per cent of the series; some were papillary, some resembled thyroadenocarcinomas, and one was classified as an acinic cell neoplasm. Prognosis was dependent on the extent of dedifferentiation and also on the extent of local invasion. These tumors tended not to be encapsulated and often gave rise to metastases. The best therapeutic results were obtained by wide excision of the tumor.

The extreme rarity of true mixed tumor of the tongue is borne out by the fact that only one was found in the series. It appeared to be inherently benign and contained very little epithelial constituent.

Excellent results followed radical surgical operations, whereas disappointing results followed the earlier policy of irradiation, particularly in the cylindroma group. It seems that, whenever possible, more radical surgical procedures should be employed in the hope that better results in the treatment of these neoplasms may be achieved.—*Irwin A. Small.*

■ Clinical and Experimental Evaluation of Suture Materials Treated with Antibiotics. E. Echeverria A., M.D., and J. Olivares, M.D. Am. J. Surg. 98:695 Nov. 1959.

The majority of suture materials currently in use are suited to the various types of surgery since they combine basic qualities such as adequate tensile strength, sterility and flexibility, and are well tolerated by the tissues. Nevertheless, any attempt to improve them is commendable as the surgical field in reality is not completely sterile because of air, particles of saliva in masks, incomplete disinfection of skin, and so forth. For these reasons the authors have undertaken a short but detailed clinical and experimental study with new nonabsorbable sutures treated with antibiotics. A new type of suture material, made of silk and cotton and previously treated with chlortetracycline or with chlortetracycline plus neomycin, was tested.

With the use of conventional surgical technics 42 patients underwent surgery. The results using this suture material were compared with results obtained using the usual suture material. It was found that the conventional nonabsorbable material with capillary

action, by permitting the passage of tissue fluids the full length of the thread, may facilitate infection by the passage of bacteria from one tissue to another. This infection may take hold if it is not inhibited by the action of the antibiotic in the suture material. Signs of intolerance were found in none of the patients. There were no cases of postoperative infection or dehiscence.

In order to study the histologic response to this material, surgery was performed on dogs which were then sacrificed 3, 4, and 8 days after the operation. At autopsy it was found that the sutures treated with antibiotics hastened the process of cicatrization whereas the sutures not prepared with antibiotics formed excessive cicatrices, causing a frank inflammatory exudative and fibrinous purulent reaction with abundant plastic fibrous reaction in the serosa. From these observations it was concluded that this new type of suture material treated with antibiotics is of great importance to the advancement of surgery.—*Myron Kaufman.*

■ CHEMICAL OSTEOSYNTHESIS. Irving Redler, M.D. Plast. & Reconstr. Surg. 5:174 Feb. 1960.

The advantages to be obtained by a method of rapid bone fixation and immediate restoration of the function are apparent. In 1958, Mandarino and Salvatore reported that they had accomplished this by chemical means, using a polyurethane polymer, Osteamer. Indirect experimental studies in dogs demonstrated replacement of the polymer by new bone in 18 to 24 months.

In February 1959 the author initiated clinical experimental investigation of this product. Fifty operations were performed on 41 patients, 7 of whom were children. The manufacturers' instructions for the preparation of Osteamer were followed carefully. The polymer did not set properly on several occasions. The difficulty was encountered in determining the mixing and the point of Osteamer. Whenever a proper quality of polymer mix was not obtained, it was discarded, or, if poor, it was removed from the bone cavity by burring and curettage, and a new batch was prepared and poured. If motion between fragments was demonstrated, the material was removed and replaced.

Patients were immobilized postoperatively by plaster of paris or traction. Weight bearing for functional use was not permitted until wound healing had occurred and only if there was clinical evidence of solid fixation.

These cases have been followed for a maximum of 8 months and a minimum of 10 weeks. Present results, therefore, can be evaluated only as to maintenance of fixation and development of bony union. Fixation is classified as a failure if any abnormal motion develops postoperatively. By these standards, healing has taken place in 9 instances, 15 have failed, and 26 are still undetermined.

Numerous complications developed in the use of this material. The Osteamer column broke completely at the fractured site in four instances, breakage occurring twice in the shaft tibia, twice in the femoral neck. Failures of this type are due evidently to insufficient strength in the imbedded material.

The amount of material that can be introduced is limited anatomically by the diameter of the medullary cavity and cannot be increased significantly by operative technics. The Osteamer column pulled away from the bone cavity in 11 patients.

Wound infection and draining sinuses of varying severity developed in 13 instances at different postoperative intervals. Three factors are believed to have contributed to this high incidence of infection: (1) the apparent foreign body reaction of the Osteamer when it becomes loose in the bone; (2) the necessity for extensive bone excavation in many of these procedures, and (3) contamination.

There has been no evidence observed of systemic toxicity to date.

It has been necessary to remove the Osteamer in four instances because of uncontrolled infection and drainage. It probably will be necessary to do this in an additional four instances. Microscopic sections of removed Osteamer showed some degree of fibroblastic proliferation within the Osteamer lacunae in

sections from the bone contact. There was no evidence of osteoblastic activity in more central portions of the Osteamer, even as late as four months postoperatively.

It is the author's opinion that at least 3 to 5 years of observation will be necessary to learn whether the Osteamer ultimately is replaced by bone in man. Until this factor is known, future use will be restricted to the treatment of pathologic factors, in unusual situations unsuitable to therapy by conventional methods.

Chemical osteosynthesis, because of its potential benefits, warrants continued careful and thorough investigation. Osteamer should be regarded as a prototype of future materials that will provide greater strength, easier handling, rapid replacement of bone, and absence of local and systemic reaction. When such a material is found, the applications of this method in the field of bone surgery will be unlimited.—*Donald B. Rae.*

■ A Study of Revascularization of Autogenous Cortical Bone Grafts in Rabbit Using Radiophosphorus. A. B. Ferguson, M.D.; P. G. Laing, M.D.; M. Grebner, and L. Madaney. A.M.A. Arch. Surg. 78:551 April 1959.

Using radiophosphorus for determination of bone vascularity is well documented. In this study 250 bone grafts were performed in rabbits. Using the radiophosphorus pick-up technic to evaluate the fate of various types of grafts it was shown that autogenous bone grafts transferred with their periosteum showed a delay in early revascularization when compared with autogenous grafts without periosteum.

There was evidence that the osteotome-cut autogenous bone grafts revascularized more rapidly than those cut with a rotating saw.

The chopped autogenous grafts showed a more rapid revascularization than the solid ones initially. This difference became less pronounced as the age of the graft increased.—*Martin F. Anderson.*

■ Cartilage Block Arthroplasty for the Correction of Temporomandibular Joint Disturbances. Edward C. Hinds, M.D., D.D.S., and A. Harold Sills, D.D.S. Am. J. Surg. 98:787 Dec. 1959.

Autogenous rib cartilage has proved to be a suitable material for use in reconstruction of the temporomandibular joint. Autogenous rib cartilage has the following advantages: (1) it is easily shaped with a knife; (2) it is easily transplanted with a high percentage of "take"; (3) it is of sufficient density to restore and maintain vertical dimension over a period of years, and (4) it seems to be satisfactory in the prevention of recurrence of ankylosis. Its chief indication is in cases of postcondylectomy deformity, although it may be as efficient as other materials in the treatment of ankylosis without deformity. It does not solve the problem of gross disturbance in instances of joint disease or trauma at an early age, although any procedure which allows function may, to some extent, minimize the subsequent deformity and malfunction.

High condylectomy is probably the procedure of choice for the refractory posttraumatic painful joint. The problem of the fractured condyle still is not wholly understood. However, residual problems following either conservative or surgical treatment for this condition may be corrected by reconstruction with autogenous cartilage. A follow-up study is presented of three patients previously reported on, and five additional instances are described. Follow-up on these range from 5 years to 3 months.—*H. J. Bloom.*

■ Translaryngeal Anesthesia: A Review. Martin Irwin and Donald Buechel. Anesthesiology 20:181 March-April 1959.

Among anesthesiologists the primary indication for transcricoid puncture is to anesthetize the laryngeal tracheal mucosa prior to oral or nasotracheal intubation. Nasotracheal intubation profits most from translaryngeal anesthesia since laryngoscopy prior to blind intubation

may be omitted. A sudden cough after injection of the anesthetic solution sprays it from the carina to the undersurface of the vocal cords; even the hypopharynx is anesthetized. The cords are relaxed and a tube may easily be inserted without hazard of spasm.

The most accessible portion of the respiratory tract inferior to the glottis is the cricothyroid space. If the thyroid notch is palpated and the finger moved caudad in the midline, the cricothyroid space is the first depression. After premedication, the procedure is explained to the patient and he lies supine with head extended, chin up and mouth closed. After the area has been cleansed, the left index finger is placed over the cricothyroid space with the right hand holding the syringe containing the local anesthetic. The patient is cautioned not to swallow, talk or cough. Without raising a skin weal, the needle is driven like a dart perpendicularly through the skin in the midline between the cartilages, then through the cricothyroid membrane until no further resistance is felt. Only four tissues are pierced: skin, subcutaneous tissue, cricothyroid membrane, and endolaryngeal mucosa. The needle tip now lies in the laryngeal lumin caudad to the vocal cords. Aspiration of air insures proper placement. The patient again is warned not to swallow or cough to avoid breaking the needle or traumatizing tissue. Injection should be performed rapidly.—*Irwin A. Small.*

■ FIBROUS DYSPLASIA OF THE MANDIBLE IN CHILDREN. Michael L. Lewis, M.D. Plast. & Reconstr. Surg. 25:161 Feb. 1960.

In fibrous dysplasia, the normal osseous structure of the spongiosa or marrow is replaced by fibrous tissue which shows a characteristic osteogenic tendency. This manifests itself in the formation of immature nonlaminated osteoid bone. Fibrous or osseous tissue may predominate; a more correct term for this condition might be fibro-osseous dysplasia.

The lesion usually begins centrally, and its growth distends the cortex and eventually erodes it; in this event, single or multiple hump-like nodules may appear on its surface. The affected bone contains white or brown spots of firm, rubbery, fleshy tissue which may vary in size from small specks to huge nodules. Interspersed osseous elements make the tissue of gritty consistency. The histologic makeup of the tumor determines its roentgenographic appearance.

Fibrous dysplasia may be monostotic or polyostotic. The single lesion, although usually sharply delineated, may appear diffuse, suggesting a multifocal origin. When the lesion is monostotic, it is extremely unlikely that other bones will become involved during the course of the disease. Polyostotic lesions usually follow a certain pattern. They may occur in both lower extremities or may be limited to one side of the skeleton. They show predilection for the craniofacial skeleton. Here, they may involve the maxilla, mandible, nasal sinuses, orbital, frontal or zygomatic region, the base of the skull, and the calvarium.

The manifold names given to fibrous dysplasia in the literature of the past indicate that concepts of its nature had changed frequently. Even today, there is not complete agreement as to the nature of fibrous dysplasia, although the concept advanced by Jaffe and Lichtenstein is finding gradual acceptance. In their view, fibrous dysplastic lesions are hamartomas, tumors originating in developmental tissue. They believe that monostotic fibrous dysplasia and osteofibroma are identical, and that the polyostotic forms (in Albright's syndrome) are more severe forms of the same condition.

Fibrous dysplasia occurs primarily in young adults, adolescents, and sometimes in children. When the long bones are affected, the symptoms are weakening of the bone's structure, distortion of the bone under physical stress, and, finally, pathologic fractures. However, in the craniofacial skeleton in general, and in the mandible in particular, the main and usually the only symptom is a deformity resulting from tumefaction. It is assumed that it is self-limiting.

In polyostotic involvement of the craniofacial skeleton, various lesions or parts of them may behave differently at various times, one growing larger and another remaining dormant.

Three cases of mandibular tumors were

selected to emphasize the great variety in the clinical picture of fibrous dysplasia. The first instance is of a 16 year old girl in whom disfigurement is slight and has remained unchanged. It seemed preferable to keep the patient under observation for a few years before considering any operative intervention.

In the second, swelling was noted in a girl at the age of six. When the patient was seven, conservative intraoral removal of the tumor was performed. Within a few months, it became apparent that the tumor was continuing to grow. The swelling of the alveolus increased to such an extent that the mouth could not be closed, and a large ulcer developed over the crest of the swelling alveolus. Since the condition became life-endangering, a hemimandibulectomy was performed about one and one-half years after the patient first sought medical attention. A bone graft restored function and esthetic appearance.

The third instance is of a typical polyostotic fibrous dysplasia, involving the left side of the craniofacial skeleton, the mandible, maxilla, ethmoids, the roof of the orbit, the base of the skull, and the calvarium. The extent of the disease and the involvement of inaccessible parts precluded any adequate excisional procedure, and rehabilitation of the patient was imperative.

These benign tumors do not always follow the "benign" course generally anticipated. Although the accepted treatment of this disease is conservative, more radical measures are indicated when the clinical behavior of the lesions requires them. Treatment cannot be curative always, but may have to aim at the best possible rehabilitation of the young patient.—*Donald B. Rae.*

■ Results of Treatment of Squamous Cell Carcinoma of the Anterior Part of the Tongue. J. B. Erich, M.D., and L. V. Kragh, M.D. Am. J. Surg. 98:677 Nov. 1959.

It was the purpose of this study to determine the end results in all patients with squamous cell carcinoma of the anterior part of the tongue who had been treated at the Mayo Clinic from 1945 to 1954, inclusive, and if possible to determine the best method of treatment. During the period represented by this study, the great majority of patients were treated by excision or electrocoagulation of the primary lesion and by some type of block dissection of the neck for handling the cervical lymphatics. Treatment in some cases was supplemented by the interstitial use of radium or radon seeds in the surgical wound in the tongue. Relatively few composite operations were employed during this period.

In many of the patients treated by electrosurgical removal, block dissection of the cervical lymphatics and ligation of the external carotid artery preceded treatment of the primary lesion. The prognosis in this group of patients was somewhat poorer than in the remaining group. The authors believe that prophylactic dissection of the neck for oral cancer, when used on an individual basis, is of value. The yield of metastatically involved cervical nodes in clinically uninvolved necks was 15 per cent in this series. It is felt that block dissection of the cervical nodes in the absence of clinically involved nodes is worth while if well lateralized lesions are selected as the basis for such dissection. In well lateralized lesions the metastasis was first evident contralaterally in only 4 per cent of cases. This low incidence of crossed metastasis in well lateralized lesions lends support to the principle of prophylactic dissection of the neck. With lesions near the midline or on the tip of the tongue, the pathway of metastasis is less predictable, and the problem of treatment of occult metastatic lesions of the neck becomes more difficult. For lesions in or near the midline, observation of the patient for the development of cervical metastasis probably is preferable to bilateral block dissection.

This study further disclosed a little difference in survival among the various treatment groups when the extent of the local and the metastatic lesions were considered. Such difference as was observed appeared to favor wide local excision or hemiglossectomy, plus removal of the homolateral cervical lymphatics as either a composite or a separate procedure. The five-year survival rate for the entire series was 46.2 per cent.—*Myron Kaufman.*

Announcements

■ Original Research Papers Requested by Society of Oral Surgeons

This year for the first time, members of the American Society of Oral Surgeons are being asked to contribute original research papers on any phase of oral surgery. The Committee on Research, headed by Lloyd E. Church, Bethesda, Md., will review all papers submitted and the two adjudged of highest merit will be incorporated in the program for the forty-second annual meeting in Phoenix October 12-15. In addition, a further award will be made as approved by the Executive Council.

Deadline for submission of papers is July 15. They should be sent to Dr. Church at 8218 Wisconsin Ave.

■ Friedrich to Direct Division of Oral Surgery at Columbia

Rudolph H. Friedrich has resigned his position as secretary of the Council on Dental Health of the American Dental Association effective July 1 to become professor of dentistry and director of the division of oral surgery of the School of Dental and Oral Surgery, Columbia University, New York.

Since Dr. Friedrich joined the Association in 1955 as secretary of the Council, he has been concerned with plans and programs for increasing the availability of dental care to all segments of the population.

A graduate of Northwestern University Dental School, Dr. Friedrich practiced dentistry in Chicago until 1941 when he entered the Army Dental Corps as a major. After his discharge as a colonel in 1946, he engaged in the practice of oral surgery in Plainfield, N. J. In 1954 he was a dental consultant to the Hoover Commission Medical Task Force. Before joining the A.D.A. staff he served as chairman of the Association's Council on Federal Dental Services. He is vice-president of the National Health Council.

■ American Dental Association's Housing Bureau Opens

The A.D.A. Housing Bureau has opened and will process orders for accommodations at the annual session in Los Angeles October 17-20 as soon as they are received. Persons planning to attend the convention are urged to fill out the form which appears in the current issue of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION promptly and return it to the Housing Bureau. Early requests are the ones most apt to receive first choice of rooms. Four choices of hotels should be given, and two of motels.

Because of the geography of Los Angeles, locations are listed by districts. The Association is negotiating for chartered buses to transport persons from central points in at least three districts to the Sports Arena where the scientific session and exhibits will be held.

■ Scientific Programs of Interest to Oral Surgeons at A.D.A. Annual Session

Three of the many programs scheduled for the scientific sessions of the annual meeting of the American Dental Association October 17-20 at Los Angeles are of special interest to the oral surgeon.

A forum on pain control, moderated by Donald Mackay of St. Paul, will include an examination of pain, its etiology and elimination, together with an analysis of the benefits and dangers in the various pain-relieving technics. Participants will be Joseph Osterloh, San Francisco, Morgan Allison, College of Dentistry, Ohio State University, and Harold J. Zubrow, Pittsburgh.

A panel discussion of the Willmar-Winona and Marshall Studies—Pilot Oral Cancer Detection Program will be conducted by James English, Office of Naval Research Code 444, Washington, D. C. Panel participants will be William G. Shafer, University of Indiana School of Dentistry, Marvin Burstone, National Institutes of Health, and Robert Gorlin, University of Minnesota School of Dentistry.

Daniel J. Holland will moderate a forum on exodontics and prosthodontics which will be conducted by William Rakower, New York, W. B. Johnson, Camp Pendleton, Calif., and James H. Quinn of the Ochsner Clinic, New Orleans. Another session of this forum will include as speakers, Leo Korchin, Fort Devens, Mass., Frank M. McCarthy, Jr., Los Angeles, and Muller M. DeVan, Philadelphia.

■ South India Dentists Lack Dental Library Facilities

P. F. John, a dental surgeon of Alwaye, South India, has sent a plea to members of the profession in the United States for used books on oral surgery and dentistry for the benefit of all members of his profession in the south of India. Dr. John states that there are no dental libraries there, that new books are extremely costly and used books scarcely available. He and his confreres practicing in the small towns and villages have many needy patients who are unable to pay for dental work, hence the incomes of the dental surgeons are very low.

The American Dental Association has dispatched a packet of books and pamphlets to Dr. John to serve as the nucleus of a library. The group is particularly interested in books on oral surgery and pathology, dental anesthesia, an atlas of oral surgery and anatomy, and textbooks on operative dentistry and prosthodontics. They would also appreciate receiving discarded surgical instruments.

Dr. John's address is Market Road, Alwaye, P. O., S. India.

■ American Institute of Oral Biology—17th Annual Meeting

The seventeenth annual meeting of the American Institute of Oral Biology will be held October 8-12 at the Hotel Riviera, Palm Springs, Calif., preceding the meetings of specialty groups prior to the annual session of the American Dental Association at Los Angeles.

By tradition families and friends are excluded from these seminar-type meetings which are devoted to work and study of the latest developments in dentistry and medicine. The host hotel is reserved for the exclusive use of the Institute.

Further information can be obtained from the office of the Institute at 2240 Channing Way, Berkeley 4, Calif.

■ Association of Dental Schools Elects Officers

Dean Raymond J. Nagle, New York University College of Dentistry, was installed as president of the American Association of Dental Schools at its thirty-seventh annual session in Chicago March 20-30.

Other officers chosen were: president-elect, Lester W. Burket, dean, University of Pennsylvania School of Dentistry; vice-president, George W. Teuscher, dean, Northwestern University Dental School; member of the executive council, Paul H. Jeserich, president of the American Dental Association and dean, University of Michigan School of Dentistry.

Thomas J. Hill, professor emeritus, Western Reserve University School of Dentistry, was elected to honorary membership in the Association. Dr. Hill is chairman of the Council on Dental Research of the A.D.A.

■ Seminar on Oral Medicine at University of Minnesota

The University of Minnesota, School of Dentistry, and the Center for Continuation Study, announce the fifteenth annual seminar for the study and practice of oral medicine. Sessions will be held at the Continuation Center in Minneapolis September 23 and 24. Further details can be obtained by writing to the Center for Continuation Study, University of Minnesota, Minneapolis 14.

■ A Correction

In the January issue of THE JOURNAL two book reviews were published. They were *Textbook of Oral Surgery* by Gustav O. Kruger, reviewed by Marvin Revzin, and *Disorders of the Temporomandibular Joint* by Laszlo Schwartz, reviewed by Paul H. Mathews.

In the May issue another review of Dr. Kruger's book inadvertently was published under the title of Dr. Schwartz' book. This review was written by Warren R. Schram. In short, two reviews of the *Textbook of Oral Surgery* were printed—one in January, and another, incorrectly titled, in May.

The publication error was in no way the fault of any of the reviewers involved, and THE JOURNAL wishes to apologize to them, to the authors and to our readers for the resulting confusion.

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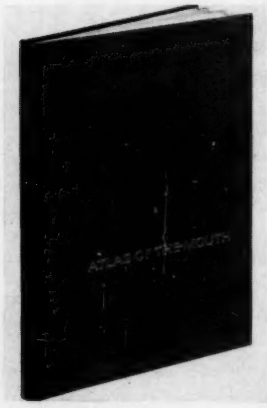

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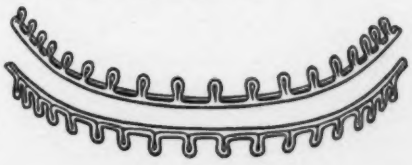

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